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New York State Education Department

# New York State Museum

## 62d ANNUAL REPORT

## 1908

In 4 volumes

VOLUME 4

APPENDIX 8

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TRANSMITTED TO THE LEGISLATURE MARCH 15, 1909

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UNIVERSITY OF THE STATE OF NEW YORK
1909

STATE OF NEW YORK

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STATE OF NEW YORK

No. 64

# IN ASSEMBLY

MARCH 15, 1909

# 62d ANNUAL REPORT

OF THE

# NEW YORK STATE MUSEUM

VOLUME 4

*To the Legislature of the State of New York*

We have the honor to submit herewith, pursuant to law, as the 62d Annual Report of the New York State Museum, the report of the Director, including the reports of the State Geologist and State Paleontologist, and the reports of the State Entomologist and the State Botanist, with appendixes.

ST CLAIR MCKELWAY
*Vice Chancellor of the University*
ANDREW S. DRAPER
*Commissioner of Education*

## Appendix 8

*Museum memoir* 9, *part* 2

Early Devonic History of New York and Eastern North America

New York State Education Department

# New York State Museum

John M. Clarke, Director

Memoir 9

## EARLY DEVONIC HISTORY

OF

## NEW YORK AND EASTERN NORTH AMERICA

BY

JOHN M. CLARKE

PART 2



ALBANY

NEW YORK STATE EDUCATION DEPARTMENT

1909

*New York State Education Department*
*Science Division, November 11, 1907*

*Hon. Andrew S. Draper LL.D.*
*Commissioner of Education*

SIR: I communicate herewith for publication, part 2 of Memoir number 9, entitled *Early Devonic History of New York and Eastern North America.*

Very respectfully
JOHN M. CLARKE
*Director and State Geologist*

*State of New York*
**Education Department**
COMMISSIONER'S ROOM

*Approved for publication this 13th day of November 1907*

A. S. Draper

*Commissioner of Education*

Dalhousie — View from Incharran hotel looking north across the Bay of Chaleurs. Eruptives of Dalhousie mountain in foreground

New York State Education Department

# New York State Museum

John M. Clarke, Director

Memoir 9

# EARLY DEVONIC HISTORY

OF

# NEW YORK AND EASTERN NORTH AMERICA

BY

JOHN M. CLARKE

PART 2

## INTRODUCTION

These papers bring together additional results of studies inaugurated for the purpose of establishing a fuller basis of comparison between the early Devonic faunas of New York and those of the regions bordering the Atlantic coast line. In large measure the data here presented are purely paleontological and faunal as I have not taken occasion in connection with the examination of the region here involved to enter into detailed consideration of problems of regional structure. The work pertains to the same line of investigations as those set forth in part 1 of this memoir, and contributes thereto a series of factors which cast light upon the problems of composition and origin of these ancient faunas. It is almost needless to remark that so long as the exact nature of the species composing the faunas of this early period remained unknown, suggestions in regard to the true succession of events, the outline and modification of the coast lines of the time and the general courses of migration must remain unsubstantiated hypotheses. Hence paramount importance has been given to the examination and identification of the species as a necessary stepping-stone to any

lasting conclusions of broader import. To these are added such details of stratigraphy as have been obtainable in regions which have suffered considerably from crustal disturbances and in some cases are well overgrown with forest. The conclusions derived from the studies bearing upon the broader themes suggested are presented cautiously and with reserve. The regions involved have yet much to reveal before these items of their geological history can be apprehended in their proper perspective. Some of the propositions here discussed have been already presented by the writer [Mus. Bul. 107, 1907 and Koenen'sche Festschrift, 1907] but in this place all details and deductions are brought together for the sake of fulness and logical connection.

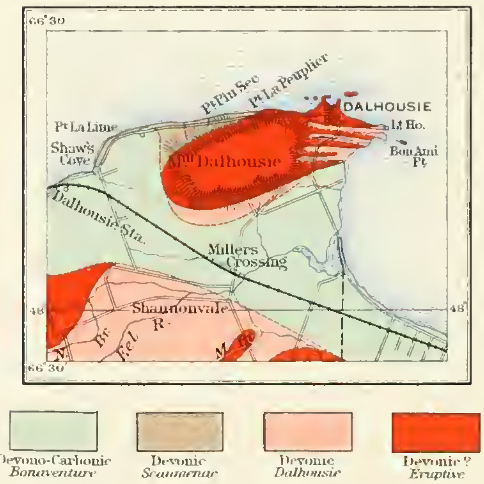
It is the purpose, first, to present in analytical form the faunas of three distinct regions outside of New York State:

*a* That of Bellevue or Stewart's cove, near Dalhousie, New Brunswick, involved in the *Dalhousie beds* of H. M. Ami,

*b* That of the much disturbed arenaceous shales of northern-central Maine extending in a belt across Somerset and Piscataquis counties in a northeast-southwest direction but probably forming no present or ancient direct connection with the Chapman sandstone of Aroostook county at the north. To these beds the term *Moose River sandstone*, introduced by H. S. Williams, is applied.

*c* That of the isolated outcrops in Aroostook county in northeastern Maine, represented in the localities of Edmunds Hill and the Presque Isle stream in the Chapman Plantation; the *Chapman sandstone* of Professor Williams.

These accounts are supplemented by some additional considerations of the Port Ewen and Oriskany faunas in New York.




SCALE, 4 MILES = 1 INCH

GEOLOGICAL MAP OF DALHOUSIE AND VICINITY

After R.W Ells, 1882

# I
# THE DALHOUSIE FORMATION

Dalhousie, lying at the upper reaches of the Bay of Chaleurs where its waters broaden out from the debouching Restigouche river, faces from the New Brunswick side of the bay the now well known site of Devonic fishes at Scaumenac. It is in fact the northernmost point of land in the Province of New Brunswick. The village rests at the foot of an intrusive volcanic boss, Dalhousie mountain, lying a mile or two back from the water. From this parallel apophyses extend seaward and in between these have been caught the series of beds whose fauna here invites our attention.

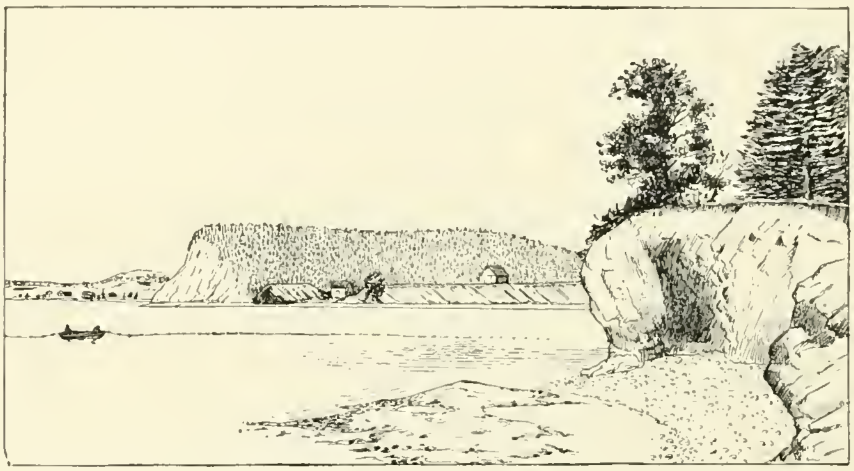
Following the shore southeastward from Dalhousie harbor beyond the Incharran Hotel to the Bon Ami rocks (a sea wrecked promontory frequently referred to by writers as Cape Bon Ami but not so known by the residents) one traverses only the section of one of these igneous arms. The inward retreat of the shore at the Bon Ami rocks marks the beginning of Stewart's cove and here the sedimentaries are exposed only in shore section and extending inland but a short distance. With these only are we here concerned. A series of about 450 feet of calcareous shales, for the most part uniformly dipping at an angle of 70 degrees toward the northeast and north rests upon the slopes of the eruptives with some degree of alteration from contact therewith and carries interbedded ash or tufa strata full of organic remains. Sedimentation was contemporary with the volcanic ejections as evinced by the ash beds and quite probably coeval with the outpouring over the sea bottom of the greater volcanic masses. These disturbances have produced no dislocations of the strata though they have hardened and glazed them along certain contacts.

### Historical note

Not much has been recorded concerning the geological situation at Stewart's cove and it is perhaps quite sufficient to quote here the account given by Sir William Dawson [Acadian Geology, ed. 4. 1891. p. 578] which summarizes the work of his predecessors in this field.

A glance at the map will enable the reader to perceive, extending southwest from Bathurst, in the Bay de Chaleur, that broad and rugged belt of altered Lower Silurian and plutonic rocks, the terror of railway engineers, which forms the natural limit of Acadia on the northwest, and separates the coal field of New Brunswick from the Upper Silurian valley of the Restigouche and Upper St John, the debatable land, in point of physical geography, between the high lands of the Nepisiguit which belong to New Brunswick, and the high lands of Rimouski and Gaspé which belong to the Province of Quebec.

This belt of very ancient rocks was probably a physical barrier even as early as the Upper Silurian period; for on passing it we find in the valleys



View of Stewart's cove looking south from near the Bon Ami rocks. The low terrace embraces only the upper division of the series. The hill in the middle distance is an interbedded intrusive mass beyond which in a shore retreat the rest of the series is concealed.

of the Restigouche and the neighboring streams, beds of highly calcareous and fossiliferous Upper Silurian rocks identical in character with those of Gaspé, and differing both in mineral character and the assemblage of fossils from those which we have just been studying. The southern limit of this Upper Silurian area, in so far as it is known, may be seen on the map; and its structure may be learned from the following description by Professor Hind of the section at Cape Bon Ami [Stewart's cove] near Dalhousie. The section is in ascending order, and the dips are to the northward at an angle of 45°.

1 Trap.

2 Calcareous shales.

3 Trap or trappean ash, more or less stratified, and with veins of carbonate of lime and quartz.

4 Calcareous shales and honestones, weathering buff or pale yellow.

5 Trap, vesicular, hard and black, weathering red.

6 Calcareous shale and limestone, with honestone. Many layers are fissile and shaly, weathering buff, others are hard and silicious. The limestones contain Favosites gothlandica, Strophomena rhomboidalis, etc. In the upper part of this series there appears to be a conglomerate 14 feet thick, capped by honestone 36 feet thick.

7 Massive trap.

8 Limestone highly fossiliferous. Among its fossils are Favosites gothlandica, F. polymorpha, F. basaltica, Strophomena rhomboidalis, S. punctulifera, Calymene blumenbachii, Atrypa reticularis.

9 Trap, highly ferruginous.[1]

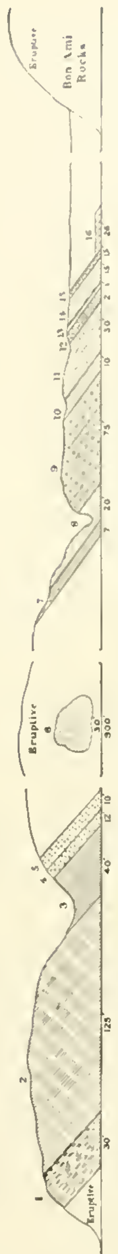
It is instructive to observe the large amount of bedded trap or volcanic ash in the above section. This accords with the presence of large quantities of apparently interstratified igneous rock in the Kingston group and in the Cobequid mountains, as already noticed. Such interstratified volcanic matters are abundant in some parts of the Silurian of Great Britain. They are comparatively rare in other parts of Nova Scotia, though beds of this kind occur in New Canaan. Similar traps occur in Gaspé, but they are absent from the typical Upper Silurian of New York and western Canada. Their presence indicates the recurrence of volcanic eruptions at frequent intervals during the Upper Silurian period.

A collection of fossils from the beds at Dalhousie and its vicinity has been kindly communicated to me by Professor Bailey, and has been submitted to Mr Billings, who regards the species as equivalent to those of the Port Daniel limestones of the northern side of the Bay de Chaleur, which may be regarded as intermediate in age between the Niagara and Lower Helderberg groups, and therefore probably not far from the horizon of the Upper Arisaig series, or perhaps between this and the Lower Arisaig group.

The following fossils from Dalhousie and Restigouche, now in the Museum of the University of New Brunswick, have been determined by Mr Billings. The assemblage is in the main that of the Lower Helderberg.

Favosites basaltica
Favosites gothlandica
Zaphrentis *n. s.*, same as one in the Gaspé limestone
Stenopora
Halysites catenulatus
Syringopora
Diphyphyllum
Orthis tubulistriata *Hall*, or allied
Orthis oblata *Hall*
Strophomena rhomboidalis
Strophomena punctifera *Conrad*
Strophomena varistriata
Spirifera cycloptera
Atrypa reticularis
Cyrtia dalmani
Rhynchonella vellicata *Hall*
Athyris princeps, or allied
Leptocoelia, allied to L. hemispherica
Fenestella
Megambonia, allied to M. ovoides *Hall*
Conocardium
Pleurotomaria, allied to P. labrosa *Hall*
Euomphalus sinuatus (?)
Dalmanites

[1] The total thickness of the above series is not stated by Professor Hind.




Diagrammatic section of the Lower Devonic beds near Dalhousie from the Bon Ami rocks at the north to the south end of the exposure. Numbers at the top indicate the subdivisions, those at the bottom the length of the shore section of these divisions.

The foregoing is a lucid sketch and gives an essential clue to the nature of the stratigraphy and the character of the fossil fauna, the affiliation of which with the Helderbergian of New York is admitted.

The field was entered by Dr Ells in 1879–80, who has briefly mentioned the area[1] and colored it on the larger map of New Brunswick, sheet 3, S. W., a small portion of which we have reproduced here. Dr Ells did not, however, enter into a detailed notice of the structure of the region at this point. It is to Dr H. M. Ami that we owe the term Dalhousie formation which we are applying to these beds [Equisse géologique du Canada, 1902, p. 27, III].[2]

**The rock section.** In the succession as here presented, though interbedded with and interrupted by volcanics, there appears to be no break, displacement or duplication by faulting, the strata dipping to the n. ne. at a high angle quite uniformly 70° to 75°. The base of the series lies at the south end.

[1] Geol. Sur. Can. Rep't, p. 20 D.

[2] The writer's first visit to this interesting locality was in 1900 in company with Prof. Charles Schuchert of the National Museum, now of Yale University. Very extensive collections were made here by both of us and subsequently at the Gaspé localities which have already been described. We then entered upon a mutual understanding by virtue of which the faunas of the Lower Devonic beds including the Dalhousie series and the St Alban and Cape Bon Ami beds of Gaspé were to be elaborated by Mr Schuchert and the faunas of the Grande Grève limestones by the writer. As time passed and the latter's work was going well forward Mr Schuchert was called to New Haven before he had found opportunity to begin his investigations, and thereupon faced by many other duties he voluntarily and very graciously relinquished to my hands the study of the entire series of faunas, and with it all the collections made therefrom by him for the National Museum. The representation of the Dalhousie fauna on which this treatise is based has, like that of the Gaspé faunas, not been meager.

In ascending order:

*South.*

*Volcanic boss* making southern slope to sea plain of a low headland overlain by

| | | FEET |
|---|---|---|
| 1 | Calcareous shale with Sieberella pseudogaleata, Leptaena rhomboidalis and in the lowest stratum corals (Favosites, Zaphrentis etc.) No contact metamorphism | 30 |
| 2 | Gray to yellowish hard calcareous shales with thin beds of limestone | 125 |
| 3 | Hard blocky yellowish gray argillaceous limestone | 40 |
| 4 | Coarse conglomeratic ash bed | 12 |
| 5 | Compacted gray blocky limestone | 10 |
| | *Volcanic boss*, 900 feet in section, near the middle of which lies a | |
| 6 | detached mass of hardened and glazed calcareous shale resting at an angle to the normal dip, measuring 30 feet in transverse thickness, 15 feet in hight and apparently entirely embedded in the volcanic matter. This mass contains corals and brachiopods | 30 |
| 7 | Compacted limestone beds overlying the eruptive; contains corals and other fossils | 7 |
| 8 | Soft calcareous shales lying at the entrance of a small stream and very rich in Leptaena rhomboidalis | 20 |
| 9 | Limestones and calcareo-argillaceous shales with profusion of corals and brachiopods | 75 |
| 10 | Soft shales with lamellibranchs | 10 |
| 11 | Ash beds alternating with thin limestones and shales all highly fossiliferous, the ash beds containing Rensselaeria stewarti in abundance | 30 |
| 12 | Blocky calcareous shale with gastropods (Coelidium) | 2 |
| 13 | Ash bed with Rensselaeria stewarti | 1 |
| 14 | Barren shales | 15 |
| 15 | Thin white limestone | 1.5 |

FEET

16 Coral reef limestone exposed only at low tide; shaly in lower part - - - - - - - - - - - - 25

From this point northward the section is concealed by an old sea beach or talus for a distance of 400 feet to the projection of the eruptive mass called the Bon Ami rocks. The total thickness of the sedimentary series in Stewart's cove is thus approximately 430 feet in a sea cliff section 1700 feet long. The fossils of the fauna have been chiefly obtained from beds 1, 7, 8, 9, 10, 11, 12, 13 and 16. In their distribution there is some uniformity but strong contrasts are also evident in the range of leading species. These facts will be evident upon study of the accompanying table.

RANGE AND DISTRIBUTION OF THE DALHOUSIE FAUNA

| SPECIES | DALHOUSIE BEDS | | | | | | | | | | | | | | | | Helderberg | Oriskany | Onondaga | St Alban | Chapman | Coblentzian |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | | | | | | |
| Spirorbis *sp.* | | | | | | | | | x | | | | x | | | | | | | | | |
| Pterygotus *sp.* | | | | | | | | | | | x | | | | | | | | | | | |
| Phacops logani *Hall v.* gaspensis *Clarke* | | | | | | | | | | | x | | | | | | (x) | | | | | |
| Dalmanites micrurus *Green* | | | | | | | | | | | x | | | | | | x | | | | | |
| Bronteus barrandii *Hall v.* major *Clarke* | | | | | | | | | | x | | | | | | | (x) | | | (x) | | |
| Proetus *sp.* | | | | | | | | x | x | | | | | | | | | | | | | |
| Beyrichia kloedeni *McCoy cf. v.* acadica *Jones* | | | | | | | | | | | | x | | | | | (x) | | | | | |
| Pachydomella *nov* | | | | | | | | | | | | | x | | | | | | | | | |
| Kloedenia marginalis *Ulrich & Bassler* | | | | | | | | | | | | x | | | | | | | | | | |
| K. manliusensis (*Weller*) | | | | | | | | | | | | x | | | | | | | | | | |
| K. retifera *Ulrich & Bassler* | | | | | | | | | | | | x | | | | | | | | | | |
| K. sussexensis (*Weller*) | | | | | | | | | | | | x | | | | | | | | | | |
| K. punctillosa *Ulrich & Bassler* | | | | | | | | | | | | x | | | | | | | | | | |
| Kloedenella pennsylvanica (*Jones*) | | | | | | | | | | | | | x | | | | | | | | | |
| K. halli (*Jones*) | | | | | | | | | | | | | x | | | | | | | | | |
| Orthoceras *cf.* longicameratum *Hall* | | | | | | | | | | | x | | | | | | x | | | | | |
| Kionoceras *cf.* rhysum *Clarke* | | | | | | | | | | | x | | | | | | | | | x | | |
| Holopea enjalrani *Clarke* | | | | | | | | | | | | x | | | | | | | | | | |
| H. enjalrani *v.* corrugata *Clarke* | | | | | | | | | | | | x | | | | | | | | | | |
| H. *cf.* antiqua *Vanuxem v.* pervetusta *Conrad* | | | | | | | | | | | | | x | | | | x | | | | | |
| Coelidium strebloceras *Clarke* | | | | | | | | | | | x | | | | | | | | | | | |
| C. tenue *Clarke* | | | | | | | | | | | x | | | | | | | | | | x | |
| Melissosoa compacta (*Hall*) | | | | | | | | | | | x | | | | | | x | | | | | |
| Platyceras *sp.* | | | | | | | | | | x | | | | | | | | | | | | |
| Euomphalus disjunctus *Hall* | | | | | | | | | | | x | | | | | | x | | | | | |
| Pterinopecten denysi *Clarke* | | | | | | | | | x | | | | | | | | | | | | | (x) |
| P. *cf.* proteus *Clarke* and wulfi *Frech ?* | | | | | | | | | | x | | | | | | | | x | | | | (x) |
| Pterinea intercostata *Clarke* | | | | | | | | | x | | | | | | | | | | | | | (x) |
| P. *cf.* pseudolaevis *Oehlert* | | | | | | | | | x | | | | x | | | | | | | | | (x) |
| P. fasciculata *Goldfs. v.* occidentalis *Clarke* | | | | | | | | | | | x | | | | | | | | | | | (x) |
| P. (Pteronitella?) incurvata *Clarke* | | | | | | | | | | | x | | | | | | | | | | (x) | |

RANGE AND DISTRIBUTION OF THE DALHOUSIE FAUNA (*continued*)

| SPECIES | DALHOUSIE BEDS | | | | | | | | | | | | | | | | Helderberg | Oriskany | Onondaga | St Alban | Chapman | Coblentzian |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | | | | | | |
| Pterinea brisa *v.* vexillum *Clarke* | | | | | | | | x | | x | | | | | | | | | | | (x) | |
| Pteronitella passer *Clarke* | | | | | | | | | | | x | | | | | | | | | | | |
| P. hirundo *Clarke* | | | | | | | | | | | x | | | | | | | | | | | |
| Mytilarca dalhousie *Clarke* | | | | | | | | | x | x | x | | | | | | (x) | | | | | |
| Modiomorpha impar *Clarke* | | | | | | | | | x | x | x | | | | | | | | | | | |
| Goniophora curvata *Clarke* | | | | | | | | | | | | | x | | | | | | | | | |
| Sphenotus ellsi *Clarke* | | | | | | | | | x | | x | x | x | | | | | | | | | |
| Carydium gregarium *Beushausen* | | | | | | | | | x | x | x | | | | | | | | | | | x |
| C. elongatum *Clarke* | | | | | | | | | x | x | x | | | | | | | | | | | (x) |
| Cypricardella norumbegae *Clarke* | | | | | | | | | x | | x | | x | | | | | | | | | |
| Macrodus matthewi *Clarke* | | | | | | | | | | x | x | | | | | | | | | | | |
| M.? baileyi *Clarke* | | | | | | | | | | | x | | | | | | | | | | | |
| Janeia *sp. ?* | | | | | | | | | x | | x | | | | | | | | | | | (x) |
| (Pectunculus ? ?) plutonicus *nov.* | | | | | | | | x | | | | | | | | | | | | | | |
| Palaeoncilo (Nuculites) folles *Clarke* | | | | | | | | | | | x | x | x | | | | | | | | | |
| Nuculana (Ditichia) securis *Clarke* | | | | | | | | | | | x | | | | | | | | | | | (x) |
| Conocardium incarceratum *Clarke* | | | | | | | | | | | x | | | | | | (x) | | | | | (x) |
| Rensselaeria stewarti *Clarke* | | | | | | | | | | | x | | x | | | | | | | | (x) | (x) |
| Sieberella pseudogaleata *Hall* | x | | | | | | | | | | | | | | | | x | | | | | |
| Camarotoechia | | | | | | | | | | x | | | | | | | (x) | | | | | |
| Spirifer concinnus *Hall* | x | x | | | | | | x | x | x | | | | | | | x | | | | | (x) |
| S. perlamellosus *Hall* | | | | | | | | x | x | | | | | | | | x | | | | | |
| Cyrtina chalazia *Clarke* | | | | | | | | | x | | | | | | | | (x) | | | | | |
| Meristella princeps *Hall* | x | | | | | | | | | | x | | | | | | x | | | | | |
| Nucleospira concentrica *Hall* | | | | | | | | | x | | | | | | | | x | | | | | |
| Trematospira perforata *Hall v.* atlantica *Clarke* | | | | | | | | | x | | | | | | | | (x) | | | | | |
| Atrypa reticularis *Linné* | | | | | | | | | x | x | x | | | | | | x | | | x | | |
| Stropheodonta varistriata *Conrad* | | | | | | | | x | x | | | | | | | | x | | | x | | |
| S. patersoni *Hall prot.* bonamica *Clarke* | | | | | | | | x | x | | | | | | | | | (x) | | (x) | | (x) |
| S. (Brachyprion) major *Clarke* | x | | | | | | | x | x | | | | | | | | | x | | | | |
| S. (B.) schuchertana *Clarke* | x | | | | | | | x | x | | | | | | | | | x | | | | |

| | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Leptostrophia becki *Hall* | | | | | | | | x | x | | x | | | | | | x | | | | | |
| Strophonella punctulifera *Conrad* | x | | | | | | | x | x | | | | | | | | x | | | x | | |
| Leptaena rhomboidalis *Wilckens* | x | | | | | | | x | x | | | | | | | | x | | | x | | |
| Orthothetes (Schuchertella) radiatus *Hall* | | | | | | | | | | | x | | | | | | x | | | | | |
| Leptaenisca concava *Hall* | x | | | | | | | | | | | | | | | | x | | | | | |
| Schizophoria multistriata *Hall* | x | | | | | | | | x | | | | | | | | x | | | | | |
| Rhipidomella hybridoides *Clarke* | | x | | | | | | | | | | | | | | | | | | | | |
| R. numus *Clarke* | | | | | | | | | x | | | | | | | | | | | | | |
| Craniella agaricina *H. & C.* | | | | | | | | | x | | | | | | | | x | | | | | |
| Crania | | | | | | | | | | x | | | | | | | (x) | | | | | |
| Pholidops ovatus *Hall* | | | | | | | | x | x | x | | | | | | | x | | | | | |
| Orbiculoidea *sp.* | | | | | | | | | | | x | | | | | | | | | | | |
| Favosites hemisphericus *M.-E. & H.* | x | | | | | | | | | x | | | | | | x | | | x | | | |
| F. helderbergiae *Hall* | x | | | | | | | | | x | | | | | | x | x | | | | | |
| Halysites catenularius *Lamarck* | | | | | | | | | | x | | | | | | x | | | | | | |
| Zaphrentis shumardi *M.-E. & H.* | x | | | | | | | | | x | | | | | | x | | | | x | | |
| Dictyonema *cf.* splendens *Bill.* | | | | | | | | | | x | | | | | | | | | | x | | |
| Hindia fibrosa *Roemer* (*sp.*) | x | | | | | | | x | x | | | | | | | | x | | | x | | |

Upon analyzing this fauna we observe that it embraces at least 73 well defined or indicated species and varieties exclusive of some undetermined corals and stromatoporoids. Of these 63 are determined with precision and may be utilized as a basis of comparison and correlation with other faunas. In the Helderberg fauna of the Appalachian gulf especially of New York there are of these 73 species, 31 which are either identical with or show affiliation to them. This fact of itself is conclusive of contemporary

Photo. by Charles Schuchert

The lowest division of the Dalhousie beds at the south end of Stewart's cove; division 1, resting on an eruptive boss

age and the extension of the Helderberg fauna southwestward through an unimpeded basin passage.

With the fauna of the St Alban beds of Gaspé there are fewer identities, 9 in all, and yet we have shown quite as emphatic agreement on the part of the St Alban fauna with that of New York as is presented by the Dalhousie formation. Different elements of the Helderberg fauna seem to have become sequestered in the embayments of this old coast, which, sharing little in common, share much with the resultant fauna.

Added to the features we have indicated, are some definite relationships to the calcareous Oriskany of the Appalachian province. It is important to notice also the very strong affinity of the pelecypod element of the Dalhousie fauna with that of the Coblentzian, a characteristic which knits the fauna in a measure to that of the arenaceous fauna of the Chapman Plantation of Maine, elsewhere considered, and demonstrates the effect of transatlantic influences on the region under consideration.

We infer, therefore, that the Dalhousie fauna is essentially Helderbergian in its constitution but modified by coming within the influence of transatlantic immigrants, though the latter effect is less evident than in the faunas of the more southerly embayment represented by the Moose river beds of northeastern Maine.

## DESCRIPTION OF SPECIES OF THE DALHOUSIE FORMATION

### **Spirorbis** sp.

Specimens common, attached to various shells.

*Horizon.* Nos. 9, 13.

### **Pterygotus** sp.

Plate 1, figure 8

There have been found several fragments of large segments of a Pterygotus but no other parts. These show a coarsely scaly surface.

*Horizon.* No. 11.

### **Phacops logani** Hall var. **gaspensis** Clarke

*See* N. Y. State Mus. Bul. 107. 1907. p.165 and this memoir, pt 1, p.119, pl 10, fig. 5, 6, 10 16

A few parts of a Phacops show no critical characters by which they can be distinguished from the form occurring on the Gaspé Forillon.

*Horizon.* No. 11.

### **Dalmanites micrurus** (Green)

Plate 1, figures 1 3

*See* pt 1, p. 120

The specimens both of cephalon and pygidium, which are identified with this species, are larger than those of the Grand Grève limestone and in the pygidium the pleurae are very clearly sulcate and tubercled. These, however, are probably but slight differences and with the New York types they are quite consonant.

*Horizon.* No. 11.

### **Bronteus barrandii** Hall var. **major** Clarke

Plate 1, figure 7

Bronteus barrandii Hall var. major Clarke. N. Y. State Mus. Bul. 107. 1907. p.167

A pygidium with the structural details of B. barrandii, but having many times the size distinctive of that species in New York and Gaspé. It has the short axis, broad median rib and seven lateral ribs on each side, all becoming obsolete on the smooth border. There is here no structural variation from the specific type but a noteworthy distinction in expression.

*Horizon.* No. 10.

### Proetus sp.

Plate 1, figures 4–6

There are two species of this genus present:

1 A small form of the type of P. phocion Billings and P. conradi Hall, widespread throughout early Devonic formations; in which the glabella is conate, broad, obscurely lobed, the anterior margin of the cranidium flat and narrow, the pygidium small with a broad and short spindle having 7 annulations, narrow pleurae with 4 or 5 duplicate ribs and a thickened border.

*Horizon.* No. 9.

2 A much larger form represented by a long pygidium with narrow axis having 7 or 8 annulations and relatively broad pleurae with 5 or 6 duplicate ribs.

*Horizon.* No. 8.

### Beyrichia kloedeni McCoy cf. var. acadica Jones

*See* Beyrichia kloedeni McCoy var. acadica Jones. Ann. & Mag. 1889. Ser. 6, 3:379, pl. 17, fig. 3–6, 8, 9

Professor Jones figures 6 specimens, described from Stewart's cove,[1] these "being referred to B. kloedeni as so many subvarietal individuals falling into one varietal group." The true B. kloedeni itself exhibits a considerable variety of lobes and furrows. The Gaspé specimens in the form of their posterior and frontal lobes, the isolation and round shape of the middle lobe and in their dimensions present individual similarities with those from Dalhousie. The middle lobe is on the whole a little shorter than in the largest from that locality, well isolated and the confluence of the large lobes is more complete. The species is not unlike B. notata ventricosa Hall from the Helderbergian though the latter has a narrower anterior lobe.

The specimens attain a length of 4 mm, a width of 2.5 mm and a hight of .9 mm. Specimens of but 1 mm in length, which evidently represent the young of the variety under consideration, differ markedly from the mature examples in the absence of one or both of the sulci bounding the middle lobe, the latter only appearing as a low prominence upon the even surface of the valve, and in the complete absence of the median ventral depression separating the two large lobes. This approach of young forms to the aspect of Primitia has been observed in the young of Beyrichiae by Verworn and Walcott.

*Horizon.* No. 12.

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[1] Termed in the original description, Cape Bon Ami.

For all following identifications of the ostracodes in the Dalhousie beds, I have been under obligations to Dr R. S. Bassler and E. O. Ulrich who have recently prepared an extended account of some of the species.[1] With regard to the form above cited there appears to be some degree of uncertainty in the minds of the authors referred to and they have not satisfied themselves that the name given does not include diverse objects.

### Pachydomella sp. nov.

Somewhat allied to P. longula Ulrich & Bassler, from the Coeymans limestone at Cumberland, Md., but distinguished from all other members of the genus by its punctate surface.

*Horizon.* No. 13.

### Kloedenia marginalis Ulrich & Bassler

(*Op. cit.* p. 301, pl. 38, fig. 16)

Similar to K. manliusensis (Weller) but has a wider margin, is more elongate and its sulci are much shallower; surface without ornament.

*Horizon.* No. 12.

### Kloedenia manliusensis (Weller)

Beyrichia manliensis Weller. N. J. Geol. Sur. Pal. 1903. 3:268, pl. 23, fig. 10
Kloedenia manliensis Ulrich & Bassler. *Op. cit.* p. 301

Described from the Manlius fauna of New Jersey.

*Horizon.* No. 12.

### Kloedenia retifera Ulrich & Bassler

(*Op. cit.* p. 302, pl. 28, fig. 18)

Not known in other localities.

*Horizon.* No. 12.

### Kloedenia sussexensis (Weller)

Beyrichia sussexensis Weller. N. J. Geol. Sur. Pal. 1903 3:252, pl. 23, fig. 3, 4
Kloedenia sussexensis Ulrich & Bassler. *Op. cit.* p. 302

From the "Decker Ferry" fauna of New Jersey.

*Horizon.* No. 12.

[1] New American Paleozoic Ostracoda: Preliminary Revision of the Beyrichiidae, with Descriptions of New Genera. U. S. Nat. Mus. Proc. 1908. 35 : 277–340, pl. 37–44.

### Kloedenia punctillosa Ulrich & Bassler

(*Op. cit.* p. 301, pl 38, fig. 17)

Similar to K. nearpassi and K. barretti (Weller) from the "Decker Ferry" fauna of New Jersey.

*Horizon.* No. 12.

### Kloedenella pennsylvanica (Jones)

Kloedenia pennsylvanica Jones. Am. Geol. 1889. 4:341, pl. 2, fig. 5a–d, 6 (not fig. 7a, 7b, 8, 9)
Kloedenella pennsylvanica Ulrich & Bassler. *Op. cit.* p. 318

*Horizon.* No. 13.

### Kloedenella halli (Jones)

Beyrichia halli Jones. Quar. Jour. Geol. Soc. Lond. 1890. Ser. 4. 46: 15, pl. 4 fig. 21
Bollia halli Ulrich. Minn. Geol. & Nat. Hist. Sur. Final Rep't. 1894. v. 3, pt 2, p. 669
Kloedenella halli Ulrich & Bassler. *Op. cit.* p. 319

In Maryland and Pennsylvania this species occurs in the Manlius waterlimes and Coeymans limestone.

*Horizon.* No. 13.

### Orthoceras cf. longicameratum Hall

Plate 1, figure 9

*See* Orthoceras longicameratum Hall. Palaeontology of New York. 1859. 3:343, pl. 71, fig. 1, 5

Smooth, large longicones with regularly convex septa and beadlike siphuncular deposits were given this name by Hall in application to specimens from the Coeymans limestone. Similarly constructed orthocerata occur in these Dalhousie beds.

*Horizon.* No. 11.

### Kionoceras cf. rhysum Clarke

*See* Kionoceras rhysum Clarke. N. Y. State Mus. Bul. 107. 1907. p. 176; this memoir, pt 1, p. 142, pl. 13, fig. 1–5

*Horizon.* No. 11.

### Holopea enjalrani Clarke

Plate 1, figures 17–19

Holopea enjalrani Clarke. N. Y. State Mus. Bul. 107. 1907. p. 187

Small, rotund, Diaphorostoma-shaped shells with greatly expanded body whorl and low reduced spire. Whorls two and one half to three, greatly overlapping, sutures not impressed; aperture entire, oval; base perforate.

Surface of final whorl regularly convex and covered with fine regular concentric growth lines. Hight of typical example 10 mm, hight of body whorl 8 mm, width across base 12 mm.

*Species name.* Father Enjalran, Recollet missioner, active on this coast about 1675.

*Horizon.* No. 12.

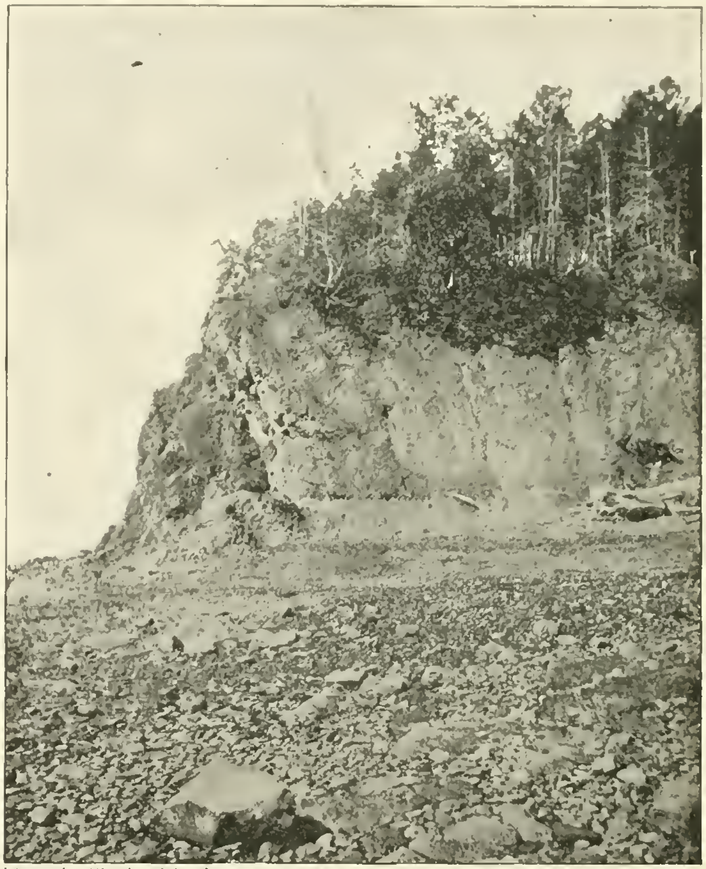

Photo. by Charles Schuchert

The steeply inclined beds at Stewart's cove, Dalhousie, resting against a volcanic sheet. Taken at low tide

### Holopea enjalrani var. corrugata Clarke

Plate 1, figure 20

Holopea enjalrani var. corrugata Clarke. N. Y. State Mus. Bul. 107. 1907. p. 187

A shell of the same proportions as H. enjalrani carries a series of rather strong oblique corrugations on the body whorl parallel to the growth

lines and somewhat swollen at the top near the suture. It is an expression unusual at this early age though well known in Carbonic shells of similar type and as the departure from H. enjalrani is alone in the clustering of the concentric growth striae into pilae, I should regard the shell a varietal expression of that species.

*Horizon.* No. 12.

### Holopea cf. antiqua Vanuxem var. pervetusta Conrad

Plate 1, figures 14–16

*See* Hall, Palaeontology of New York. 1859. 3:294, pl. 54, fig. 2, 3

The shells of this type from Dalhousie are essentially like those figured by Hall as Holopea antiqua but have the less marked difference in size of body whorl which brings them into closer resemblance to the variety cited but which was not well known to Hall. These shells are common at Dalhousie, have uniformly convex whorls 3 to 4 in number, the last being regularly rounded and transversely or concentrically striate. The aperture is round or slightly oblique and the inner lip excavate.

*Horizon.* No. 13.

### Coelidium strebloceras Clarke

Plate 2, figures 7–9

Coelidium strebloceras Clarke. N. Y. State Mus. Bul. 107. 1907. p. 189

An extremely elongate and terete shell with not less than 20 volutions at full growth. The best preserved specimen has a length of 70 mm, and a width at the base of 11 mm. The latter whorls display a sharp median angulation with a moderately broad and distinct slit band from which the slope to the suture is abrupt, more distinct and flattened above, more convex below.

This singularly delicate "Murchisonia" carries to an extreme the expression presented by some of the species described by Hall from the Guelph and by Lindstroem from the Gothlandian.

*Horizon.* No. 11.

### Coelidium tenue Clarke

*See* page 99

*Horizon.* No. 11.

### Melissosoa compacta (Hall)

Plate 2, figures 1–6

Loxonema ? compacta Hall. Palaeontology of New York. 1859. 3:297, pl. 54, fig. 12

Under the name cited Professor Hall described a shell from the Lower Pentamerus (Coeymans) limestone of Schoharie, N. Y., which is peculiar

in its greatly extended spirals, low, narrow and numerous whorls (13 in the typical specimen), very direct and transverse sutures. The shell is extremely uncommon in New York but in the Dalhousie fauna it is one of the abundant species and no doubt exists of the specific identity in the two localities. The original is a palpable internal cast; those at Dalhousie usually retain the external markings and these show that the shell is wholly without external evidence of a slit band, while the surface is otherwise quite smooth and bears simple concentric growth lines. Like the shells we have referred to the genus Coelidium,[1] it has an open umbilicus extending to the tip of the spire, but Coelidium, of which we have representatives in this fauna, carries a slit band. A few of our many specimens suggest on the internal cast but not on the exterior the presence of a slit band, very vague and uncertain, confined to the later whorls only and though this evidence is slender, not shown on the outside, it points to the relation of this shell to Coelidium. So peculiar is the aspect of the shell that it may be well to distinguish it by the generic term used above.

*Horizon.* No. 11.

### Platyceras sp.

Plate 1, figure 13

A rather large deeply furrowed and corrugated shell similar to P. retrorsum Hall of the Helderbergian [*see* Palaeontology of New York, 1859. 3: 320, pl. 58, fig. 10; pl. 59, fig. 9].

*Horizon.* No. 10.

### Euomphalus disjunctus Hall

Plate 2, figures 10–14

Euomphalus disjunctus Hall. Palaeontology of New York. 1859. 3: 340, pl. 65, fig. 8; pl. 67, fig. 4

This species was described from internal casts and the specific name has reference to the condition of these whorls in the cast, but the specimens from Dalhousie where the shell is abundant and shows nothing to separate it from the New York form, retain the shell substance and show clearly the union of the whorls throughout their course. In these too the difference between the upper and lower sides of the spiral is well marked, the former being but slightly overpassed by the final whorl while the latter is deeply depressed.

*Horizon.* No. 11.

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[1] N. Y. State Mus. Mem. 5, p. 67.

### Opercula of Gastropods (Euomphalus ?)

Plate 1, figures 10–12

Associated with the gastropods described are discoid bodies having the aspect of large Orbiculoideas, with an apparently concentric surface lineation, and a considerable thickness of substance.

The markings on these are really close wound spirals beginning at a central or subcentral apex. The bodies are sometimes flat from compression, but usually convex and have an aspect similar to these which by Whiteaves, Lindstroem and Spitz have been looked upon as opercles.[1]

*Horizon.* No. 11.

### Pterinopecten denysi Clarke

Plate 3, figure 7

Pterinopecten denysi Clarke. N. Y. State Mus. Bul. 107. 1907. p. 199

Shell moderately large, subcircular, known only from its left valve which in the single specimen before us is somewhat incomplete about the hinge but has a very characteristic sculpture. This consists primarily of a few strong radial ribs of unequal size, which rapidly spread apart leaving broad interspaces which do not, in any noticeable degree on the body of the shell, become occupied by other ribs, except small and simple ones of a secondary series. The primary ribs themselves widen, become broad and flat and split up into lesser ones, though all derived from the division of any rib may remain together in a fascicle. On the anterior part of the shell the diffusion of the riblets is less defined and regular. All these are crossed by very fine reticulating concentric striae. This is a style of irregular sculpture which with more specimens would probably prove to be quite inconstant and is in a measure reproduced in the very variable species from the Oriskany of New York, which we have designated as P. proteus. A similar aspect is presented by the P. wulfi Frech from the lower Coblentzian of the Eifel.[2]

*Species name.* Nicholas Denys, in 1672 proprietor of all the country from Cape Canso to Cape Rosier.

*Horizon.* No. 9.

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[1] *See e. g.* Whiteaves. Palaeozoic Fossils. 1884. 3: 33, pl. 3, fig. 10, 11; pl. 7, fig. 7.

[2] Devon. Aviculiden Deutschlands, p. 25, pl. 2, fig. 7.

### Pterinopecten cf. proteus Clarke and wulfi Frech

Plate 3, figure 1

Pterinopecten proteus Clarke. N. Y. State Mus. Mem. 3. 1900. p. 32, pl. 4, fig. 4–8; and

Pterinopecten wulfi Frech. Devon. Aviculiden Deutschlands, p. 25, pl. 2, fig. 7

The small specimen figured here under enlargement is compared with the species above cited from the Becraft Mountain Oriskany of New York and the Lower Coblentzian of the Eifel.

*Horizon.* No. 10.

### Pterinea intercostata Clarke

Plate 3, figures 8–12

Pterinea intercostata Clarke. N. Y. State Mus. Bul. 107. 1907. p. 206

Shell suberect or oblique with small auricle and well defined, broad but not extended posterior ear. Hinge straight, about two thirds the greatest diameter of the shell. Beaks anterior, subterminal. Left valve with coarse and strong radial ribs separated by broad flat interspaces. Of these one can count about 12 on the body of the shell. The primary interspaces are usually divided by a much finer median riblet but further subdivision is very unusual. On the broad posterior wing radial ribs are sparse and indistinct though usually traces of them may be seen. Here the fine concentric lines predominate, giving the surface a smoothness in contrast to the rest of the valve. The concentric lines are also visible on the rest of the surface. As usually preserved they make faint interruptions of the radial ribs but when normal are lamellose and strongly defined. The right valve is practically devoid of radial sculpture, the surface being crossed by sharply defined concentric lines, only the posterior wing showing a few riblets on the cast. The contrast in the markings of the two valves is extreme but is conclusively demonstrated by several specimens with both valves retained.

This species may be compared in respect to ornament with several coarsely ribbed shells, e. g. P. costata Goldfs., Avicula rigomagensis Frech, from the Coblentzian, A. reticulata Sowerby, from the Aymestry limestone, but such comparisons are resemblances only in one or another feature. No closely allied form is now recognized.

*Horizon.* No. 9.

### Pterinea cf. pseudolaevis OEhlert

Plate 2, figures 2, 3

This is a smooth-shelled species of suberect form with evenly convex, subcircular lower margin, broad but not extended or deeply concave posterior wing. The body of the left valve is not highly convex nor prominently set off from the posterior wing to which it slopes quite gently. The

anterior wing is small, the beak subterminal and anterior slope quite direct. Concentric growth lines only are visible on the surface. This is a species suggestive of several which have been described from late Siluric and early Devonic beds, e. g., P. retroflexa Wahl. (Upper Ludlow) and specially P. pseudolaevis Oehlert from the lower Coblentzian, from which it seems to differ in form only in its smaller anterior wing.

*Horizon.* Nos. 9, 13.

### Pterinea fasciculata Goldfuss var. occidentalis Clarke

Plate 4, figures 1-7

Pterinea fasciculata Goldfuss var. occidentalis Clarke. N. Y. State Mus. Bul. 107. 1907. p. 205 (figures of P. cf. occidentalis fasciculata on p. 204)

*See* Pterinea fasciculata Goldfuss. Petrefacta Germaniae, 2:137, pl. 129, fig. 5, and Frech. Devon. Aviculiden Deutschlands. 1891. p. 84, pl. 8, fig. 1; pl. 9, fig. 1-3

This extremely common shell is essentially a miniature of P. fasciculata Goldfuss. Though reduced in all its proportions and in the strength of its ornament yet it expresses excellently the characters of the German species. The valves are both convex, the left notably and the right but slightly. The left valve has the body well elevated above the posterior wing. This wing is sometimes more incurved at the margin and more extended at the point than in the figured German specimens but these features are variable in the Dalhousie shells. The body of the shell or direction of the crescence line is commonly more oblique than in European specimens but this is an expression due in some measure to mode of preservation, for examples occur here quite as erect as those referred to. The breadth of the byssal groove and emargination on the valve are also notable; together with the relative development of the anterior ear they are in full agreement with P. fasciculata. The surface of this valve is marked by coarsely fasciculated radial striae. The major ribs do not exceed five or six but these are widely separated on the body of the shell, the interspaces occupied by radii of lower order.

On the posterior slope the striae are of uniform size and are visible on the wing. On the anterior wing there are two or three coarse riblets but the byssal sinus is deep and without radii. Crossing these elevated radial lines are fine crowded and elevated concentric lines giving all the surface except the byssal sinus a reticulate ornament.

The right valve is much less convex than the left, the anterior wing relatively large, the byssal sinus deep, the body of the shell depressed. The surface bears a few simple filiform radial lines along the body of the shell and others are visible on the posterior wing at the hinge. No concentric lines are evident.

*Horizon.* No. 11.

### Pterinea (Pteronitella ?) incurvata Clarke

Plate 3, figures 13-18

Pterinea (Pteronitella ?) incurvata Clarke. N. Y. State Mus. Bul. 107. 1907. p. 210

Valves elongate on the hinge, the greatest length of the hinge being almost twice the hight of the shell. Anterior wing well defined on both valves, byssal sinus not deep but broad and not marked by a notch on the right valve. Beaks one third the length of the hinge from the anterior extremity. General outline very oblique. Left valve highly convex and incurved over the body, sloping abruptly to the posterior wing, more gradually to the broad byssal sinus in front. From the prominent umbo the crescence line swings in a curve backward and forms a strong projection on the lower margin. The posterior wing is extended well beyond the posterior margin of the body and bounded by a concave curve which terminates in an acute point. Its surface is depressed in a direction conforming with the curve of the body. The surface of this valve is covered with regular concentric growth lines which are essentially unmodified on the anterior and posterior wings but the body of the valve bears radial striae which have somewhat the aspect of unequal and flat riblets produced by series of incised lines. These multiply and broaden unequally presenting much the same aspect as those in P. edmundi of the Chapman Plantation. [*See* p. 103]

The right valve is depressed; on the posterior wing deeply concave, convex but not elevated along the crescence line, thence sloping to the lower margin with an incurved surface, the postlateral edge of the valve being upturned. The byssal notch and sinus are indicated by a marginal incurvature and depression. One specimen shows the striated ligament area, a small anterior adductor and slender anterior tooth. Surface of this valve entirely smooth or with concentric lines only.

This shell is characterized by its extreme convexity and incurvature.

*Horizon.* No. 11.

### Pterinea brisa var. vexillum Clarke

Plate 3, figures 5, 6

Pterinea brisa var. vexillum Clarke. N. Y. State Mus. Bul. 107. 1907. p. 209

A left valve is suberect with a semicircular lower margin, deep byssal sinus, short but well defined anterior wing and broad posterior wing extended to an acute posterior angle. Its surface is flat or slightly concave in the pallial region. The sculpture consists of fine radial riblets of subequal size moderately distant and numerous over the body of the valve, very obscure on the posterior wing, which is entirely covered by concentric crowded lamellose lines; the latter are extremely faint over the rest of the shell. A

less complete specimen in which the left valve is impressed upon the right shows that the surface of the latter was crossed by very strong radial and very distant ribs, the broad flat interspaces sometimes carrying intercalating ribs of lower order. These were crossed by concentric lines, presumably lamellae. The aspect of the surface is thus not unlike that of P. intercostata but the outline is very different and the right valve is distinctly ribbed. The species P. brisa from Chapman Plantation [*see* p. 104], the description of which is based on a right valve, is a very close approach to

Photo. by Charles Schuchert

Intrusives at Stewart's cove, Dalhousie, with interbedded sediments

this in respect to outline and surface characters, though a more elongate, erect shell. To express this intimate relation the present form is regarded as a variety of the latter.

*Horizon.* Nos. 8, 9.

### Pteronitella hirundo Clarke

Plate 4, figures 8-11

Pteronitella hirundo Clarke. N. Y. State Mus. Bul. 107 1907. p. 211

Shell much elongate on the hinge, terminating posteriorly in a slender, acute point, anteriorly blunt, the auricle atrophied and the anterior slope of

the valves abrupt. Beak subterminal, elevated, umbonal ridge subparallel with the anterior margin. From this ridge the surface of the left valve slopes very gradually downward and back; right valve flat except at the beak. Surface of left valve bearing sharp and numerous radial lines, crowded and with a tendency to fasciculation over the anterior and lower parts but equidistant posteriorly. The hinge and ligament areas are bounded and crossed by a few very strong striae, the cardinal edge of the valve being thickened. All these lines are crossed by concentric striae, short and elevated everywhere except on the posterior cardinal surface. On the right valve the radial lines are obsolete except on the posterior wing near the hinge, only the concentric lines standing out sharply and equidistant. The inner surface of both valves is quite smooth. This is a striking species well defined by its outline and surface characters. Its thin shell has left insufficient evidence of its dentition but I have referred it to Pteronitella largely because of its general aspect.

*Horizon.* No. 11.

### Pteronitella passer Clarke

Plate 4, figures 12–14

Pteronitella passer Clarke. N. Y. State Mus. Bul. 107. 1907. p. 212

This differs from the preceding in presenting a less extended and rather blunt posterior extremity, a more conspicuous anterior ear and a relatively greater breadth. The outline is still elongate with a gentle surface slope on all sides except the front where it is quite abrupt. The surface is fully reticulated by radial and concentric lines, the former being as before stronger along the posterior wing.

In my judgment this will be readily distinguished by its outline as exhibited in two left valves here figured, though it is undeniably similar to P. hirundo in many of its characters.

*Horizon.* No. 11.

### Mytilarca dalhousie Clarke

Plate 5, figures 18–22

Mytilarca dalhousie Clarke. N. Y. State Mus. Bul. 107. 1907. p. 216

*Cf.* M. ovata Hall. Palaeontology of New York. 1859. 3:279, pl. 50, fig. 7. M. solida Maurer. Fauna d. rechtsrhein. Unterdevon. 1886. p. 13; Frech. Devon. Aviculiden Deutschlands, p. 143, fig. 15

Mytilarca is not common in early Devonic faunas. The specimens of the genus from the Dalhousie fauna are well developed in respect to generic characters and of moderately large size approaching in dimensions the Helderbergian species Megambonia ovata Hall which has never been well described or figured though its relation to Mytilarca has long been recognized;[1] and in outline and contour Myalina solida Maurer of

[1] N. Y. State Mus. Mem. 3. 1900. p. 89.

the Lower Coblentzian where such species are rare. Mytilarca dalhousie is elongate subovate in outline, with short straight posterior hinge and long abruptly deflected anterior margin extending to the basal curvature of the valves with a slightly sinuous curve. The surface is regularly but slightly convex with the greatest elevation along the anterior crescence line and the slope thence gradual in all directions except anteriorly, where it is curved down and inward. The general expression of the shell will be better appreciated from the figures than by description. There are large and small shells present with these characters, all representing the same specific form.

The hinge characters are excellently shown in one specimen of the left valve. The beak is terminal; beneath it is the apex of the broad ligament area which is strongly striated horizontally. The anterior edge of this area slopes obliquely back to the inner apex of the valve and at this point is a single oblique elongated tooth, doubly crenulated on the crest leaving between it and the edge of the ligament area a pit or socket for the reception of the tooth of the other valve. This socket is bounded below by a continuation of the tooth. Toward the posterior end of the hinge is an oblique but obscure ridge below the ligament area. This hinge structure is in agreement with Hall's delineation of it for the genus Mytilarca. The umbonal region of the shell is thick and the posterior margin shows successive thickened layers of shell growth.

*Horizon.* Nos. 9, 10, 11.

### Modiomorpha impar Clarke

Plate 6, figures 6-8

Modiomorpha impar Clarke. N. Y. State Mus. Bul. 107. 1907. p. 217

Shell of small or medium size with straight hinge line not extending for the full length of the valves. Beaks anterior but not terminal, depressed, the umbonal region rising gradually and soon broadening out over the low posterior slope. In front of this ridge the surface is gently depressed making a distinct sinus in the lower margins specially on the left valve. Anterior margins relatively narrow and blunt, posterior extremity broadly rounded. Postumbonal slope gently concave. Surface covered with regular concentric lines.

*Horizon.* Nos. 9, 10, 11.

### Goniophora curvata Clarke

Plate 4, figures 22, 23

Goniophora curvata Clarke. N. Y. State Mus. Bul. 107. 1907. p. 225

Shell of medium size, elongate, hinge line usually concealed, but apparently short, not extending posteriorly to within one third of the shell's

length of the end. Beaks anterior, subterminal, valve slightly excavated in front beneath them, making the anterior extremity relatively narrow. The umbonal ridge is obliquely curved and lies high on the valves making the postumbonal slope narrow.

The specimens of this shell are not common and it would seem the width of the postumbonal slope and the position of the ridge are subject to variation by compression. In forms where this postumbonal slope is broader the shell approaches the Orthonota solenoides Sow.,[1] of which specimens are before us from the Upper Ludlow of Bradnor lane, Kingston. The latter shell, however, is broader and more produced behind and has a shorter and more oblique hinge line.

*Horizon.* No. 13.

### Sphenotus ellsi Clarke

Plate 4, figures 24-26

Sphenotus ellsi Clarke. N. Y. State Mus. Bul. 107. 1907. p. 226

Shell elongate, subrectangular, hinge line and lower margin parallel. Beak at the anterior fourth of the hinge, anterior slope uncurved, anterior margin broadly rounded. Umbones not elevated, flattened and divided by a sinus or cincture which traverses the valves obliquely backward though without greatly affecting the regularity of the basal margin. Umbonal ridge sharply developed, not crested; extending to the postlateral angle. Postumbonal slope broad and concave, its outer edge constituting the entire posterior margin of the valve which slopes forward to the hinge. This concave area is traversed by an obscure radial ridge. Surface of the valves covered with fine concentric striae in low and irregular undulations over the shell body; these however are absent on the posterior slopes where sharp concentric lines alone are visible. Length about one third the hight.

This species appears to be closely related to the Sanguinolites decipiens McCoy[2] from the Upper Ludlow of Kendal and North and South Wales.

*Species name.* Dr R. W. Ells, Canadian Geologist.

*Horizon.* Nos. 9, 11, 12, 13.

### Carydium Beushausen

In his exhaustive and most helpful treatise on the Devonic pelecypods of Germany the late Professor Beushausen introduced the above name for a group of small shells, equivalve, inequilateral, with well defined adductor scars and hinges constructed of a thickened hinge plate on which are two

[1] Murchison. Siluria. Ed. 3. pl. 23, fig. 9.

[2] British Paleozoic Fossils. p. 277, pl. 11, fig. 24.

deep sockets beneath the beak of the left valve, the posterior one often elongated and running subparallel to the hinge margin; the inner sides of these dental ridges, when well preserved, are seen to be finely striated transversely, suggesting the appearance of Nucula, though these transverse lines do not develop into distinct pits as in that genus.

The right valve has processes corresponding to these pits. The shells have regularly closing margins all around and are more or less transverse with slightly projecting umbones. Their hinge structure indicates affinity with the Cardiniidae. Of these shells two species were described, C. gregarium and C. sociale, both from the Siegen greywacke of Singhofen and neighboring localities where they seem to be extremely abundant and of gregarious habit.

It is interesting to note that the most abundant of the pelecypods at Dalhousie is of this type.

### Carydium gregarium Beushausen

Plate 5, figures 6-12

See p. 141

Carydium gregarium Beushausen. Lamellibranchiaten der rheinischen Devon. 1895. p. 156, pl. 14, fig. 1-6

Between these very abundant shells at Dalhousie and those described by Beushausen I can find no distinction. These are small, slightly inequilateral shells with considerable convexity; beaks not far in front of the middle with full umbones; crescence line full and rounded but not prominent, and outline transversely oval, expanding posteriorly. The surface of these shells is smooth and they appear to have been without the fine concentric lines of Nucula and the Palaeoneilos which they resemble in the features usually exposed. The hinge, so far as seen, is in accord with the characterization of it as given by Beushausen and the adductor scars are frequently apparent, the anterior being generally the more conspicuous. The valves measure from 10 to 12 mm in length with a greatest hight of 5 to 6 mm.

*Horizon.* Nos. 9, 10, 11.

### Carydium elongatum Clarke

Plate 5, figures 13-17

Carydium elongatum Clarke. N. Y. State Mus. Bul. 107. 1907. p. 227

This is distinguished from its associate C. gregarium Beushausen by its longer and narrow valves which are quite regularly convex from a transverse median line, the surface sloping thence uniformly above and below, leaving the umbones depressed. The anterior end is visibly narrower than the posterior though the latter is not greatly expanded. The

beaks are situated about one third the hinge length from the anterior end and the region in front of the beaks is somewhat excavated. The hight of the shell is about one third of the length. The surface is covered by concentric lines only.

*Horizon.* Nos. 9, 10, 11.

### Cypricardella norumbegae Clarke

Plate 6, figures 1-4

Cypricardella norumbegae Clarke. N. Y. State Mus. Bul. 107. 1907. p. 227

Shell short, subrectangular, broader behind than in front, beaks well forward, umbones prominent, umbonal ridge well developed and dividing the valves so as to leave a broad postumbonal slope which is slightly depressed or concave. Hinge line short, not extended in front. Shell margin curving from a broad anterior extremity with an outward bend into the basal margin which becomes direct near the umbonal ridge where it turns sharply almost at right angles, curving outward, upward and forward and joining the hinge in an obtuse angle. Hinge with the characteristic median tooth just beneath and in front of the beak on the left valve.

Shell substance thick, surface with regular concentric growth lines and sometimes a vague radial fold in the postumbonal slope.

*Horizon.* Nos. 9, 11, 13.

### Macrodus matthewi Clarke

Plate 4, figures 15-18

Macrodus matthewi Clarke. N. Y. State Mus. Bul. 107. 1907. p. 234

Shell quite small, obliquely ovate, much broader behind with obliquely curving lower margin and broadly rounded posterior extremity. The hinge is not long and slopes at its posterior end to the posterior curve. The beak is well forward, nearly terminal, umbones prominent, umbonal ridge arched, oblique, high, fading out posteriorly. A broad sinus lies medially in front of the umbonal ridge and produces an inward curve on the lower shell margin. Length and posterior hight of the shell nearly the same.

*Species name.* Dr G. F. Matthew, Canadian geologist.

*Horizon.* Nos. 10, 11.

### Macrodus ? baileyi Clarke

Plate 4, figures 19, 20

Macrodus ? baileyi Clarke. N. Y. State Mus. Bul. 107. 1907. p. 234

Shell small, elongate, gradually expanding backward. Beaks at about one third the length of the hinge from the anterior extremity. Hinge line rounding broadly backward. Umbonal ridge or crescence line high, posterior

well defined in early growth but becoming obscure in later stages. Anterior extremity well rounded, the lower margin of the valves incurving medially and rounding again to the broader and rather blunt posterior extremity. The surface of the valves is rendered concave medially by a broad not sharply defined sinus passing from the umbones to the lower margins. Contour quite regularly convex on each side of the sinus. The length of the shell is somewhat less than thrice the hight. Surface smooth. The hinge structure of this shell has not been definitely determined but the species is provisionally referred to Macrodus.

*Species name.* Professor L. W. Bailey, Canadian geologist.

*Horizon.* No. 11.

### Janeia sp. ?

The Dalhousie beds contain modiomorphoid shells of small size without greatly expanded posterior extremity or well defined umbonal ridge; indeed they are notable for the absence of features which may guide to their positive generic determination and I am disposed to place them with Janeia, the Devonic species of which afford expressions of this kind.

*Horizon.* Nos. 9, 11.

### (Pectunculus ??) plutonicus nov.

Plate 6, figures 11, 12

Views are given on the plate referred to of a subspherical pelecypod with an exterior singularly arcoid in expression, indeed suggesting the genus to which in all probability it can not belong — Pectunculus. Such specimens as these figured retain the shell substance which is heavy and thick, have highly gibbous umbones and overarching incurved beaks. The ligament area extends for the entire length of the hinge, is very broad, the two surfaces in conjoined valves sloping toward each other at a sharp angle, and is deeply striated longitudinally. It is this ligament area taken in combination with the contour of the shell that gives it the aspect of a Pectunculus. Every effort to separate the valves in order to express the true character of the hinge has been unavailing but this will eventually become known and a correct generic assignment of the species made. The surface of the shell is marked only by concentric growth lines which do not interrupt the general smoothness of the exterior. The characters of the shell are sufficiently distinctive to justify the use of a species name even though the generic structure is still undetermined.

Together with this large and rotund species occur others of less convexity and without any defined ligament area but with similar outline and a very like relationship of the valves. Such shells are shown on plate 9, figures 10 and 11. These may prove to be of the genus Edmondia but the figures given serve only to indicate the presence of this species in the fauna.

*Horizon.* No. 8.

## Palaeoneilo (Nuculites) folles Clarke

Plate 7, figures 1-3

Palaeoneilo (Nuculites) folles Clarke. N. Y. State Mus. Bul. 107. 1907. p. 222

This is a species of the type of Nuculites branneri Clarke from the Maecurú river[1] and Cucullella ovata Sow. from the Tilestones of Horeb Chapel[2] but while it approaches both of these very closely there is only the barest indication in the specimens before us of the ante-

Photo. by Charles Schuchert

Devonic beds at Stewart's cove, Dalhousie, nos. 7 and 8. The northerly dip of the strata is shown.

rior clavicle shown by a slender depression in the sculpture casts while the other characters of the shell are those of Palaeoneilo, even to the presence of a slight posterior sinuosity or oblique depression which brings it into comparison with P. orbignyi Clarke from Maecurú[3] in which the surface is covered with very fine concentric lines, and with a number of more coarsely marked sinuous species from the Coblentzian.

*Horizon.* Nos. 11, 12, 13.

[1] Archivos do Mus. Nacional Rio de Janeiro. 10:73, pl. 8, fig. 6-8.

[2] Murchison. Siluria. Ed. 3, pl. 34, fig. 17.

[3] *Op. cit.* p. 74, pl. 8, fig. 14-17.

### Nuculana (Ditichia) securis Clarke

Plate 7, figures 4-9

*Cf.* Nuculana securiformis Goldfuss (sp.) Petrefacta Germaniae. 2: 151, pl. 124, fig. 8 and Beushausen, Devon. Aviculiden Deutschlands, p. 59, pl. 4, fig. 26-28
Nuculana (Ditichia) securis Clarke. N. Y. State Mus. Bul. 107. 1907. p. 233

Shell small, transversely elongated and snouted, beak approximately median, hinge line sloping slightly in front, deeply incurved behind. Posterior extensions narrow, curved gently upward at the extremity, anterior extremity broad and blunt; umbones not prominent, umbonal ridge obscure; greatest convexity of the valve anterior near the hinge; surface generally convex over the body of the shell, depressed toward the posterior extremity; hinge toothed almost to the extremity of the posterior extension, while the marginal surface along the extension is excavated and slightly ridged. Just within the position of the muscle scars which are usually faint are two faint shell ridges or clavicles preserved as grooves on the sculpture casts. Of these the anterior is the larger, both are broad and low, but the structure is altogether unusual though not unexpected in this genus. This structure is expressed in Nuculites by the strong development of an anterior ridge and in such forms occasionally the two ridges appear as in the species N. (Cucullella) elliptica Maurer of the Coblentzian for which Sandberger proposed the generic term Ditichia because of this structure. Beushausen however considers this development of a second ridge of only specific value and embraces such species within Cucullella. For the same reason we may hold the present species within the genus Nuculana though shells of this lediform type have not before shown such structures. The presence of these muscular clavicles is the only apparent difference between this shell and the Nuculana securiformis Goldfuss of the Coblentzian.

The surface of the valves is covered with very fine concentric striae.

*Horizon.* No. 11.

### Conocardium incarceratum Clarke

Plate 5, figures 1-5

Conocardium incarceratum Clarke. N. Y. State Mus. Bul. 107. 1907. p. 235

This species will be found a close ally of C. inceptum Hall, whose form and surface characters as occurring in the Oriskany of Becraft mountain I have already delineated in State Museum Memoir 3. The shell sometimes attains a larger size than the New York species; its form is the same but its exterior differs in the following particulars. The ornament is not so fine, the radial lines less numerous and the deep concentric lamellae can be traced continuously across the shell while in C. inceptum they

are so interrupted by the radial ribs on the body of the shell as to form radial rows of deep meshes which often alternate in their position in adjoining rows. The meshes in C. incarceratum are much the larger transversely. The anterior ridge is sharply elevated and crested, the anterior slope very abrupt, excavated and striated by the elevated concentric lamellae which here take on a radial attitude. The posterior termination is extended and acute and the valves gape at this end. These specimens show very clearly the structure of the sculpture or prismatic layer of the shell in these species, which is rendered distinctly cavernous by the projection of the concentric growth in the form of pronounced lamellae rising from the deep intervals between the ribs and dividing these areas into series of elongate pit-shaped meshes.

I have been disposed to regard these shells identical with C. rhenanum as described and figured by Beushausen [*op. cit.* p.402, pl. 30, fig. 5–8]. There is agreement between the two in respect to size, form and radial markings but the lamellar surface structure is not defined in sufficient detail to determine whether it corresponds to that of the Dalhousie shell or that of C. inceptum Hall. As there is a palpable difference herein we have preferred to give these shells a distinctive designation. Conocardium rhenanum is from the Coblentz quartzite and the Upper Coblentzian of the Rhine.

*Horizon.* No. 11.

Other pelecypod remains occur in these strata, some of them indicating notable species but the specimens before us are not in favorable preservation.

## Rensselaeria stewarti Clarke

Plate 7, figures 10–20

Rensselaeria stewarti Clarke. N. Y. State Mus. Bul. 107. 1907. p.239

Shell naviculate, the unequal convexity of the valves being very marked. The ventral valve is highly convex and arched, the line of greatest curvature being median from which the slope is somewhat abrupt to the sides giving the valve a subcarinate exterior. The umbo of this valve is high and overarched, projecting far beyond the hinge line, the apex being incurved and truncate. The cardinal area is represented by a flattened triangular area free of striae and rather definitely delimited. The dorsal valve is gently and evenly convex with low and inconspicuous umbo and beak. The surface of both valves is covered by abundant subequal radial riblets all of which are simple and continuous from beak to margin except in rare instances where additions are introduced. There is considerable difference in the coarseness of the radial marking in mature shells, the number being as low as 40 and as high as 80 to 90 on each valve.

The radial lines are crossed by exceedingly fine concentric striae. On

the interior the ventral valve shows a deep muscle scar and strong dental plates, the former not being striated by the plications of the shell. On the dorsal valve is a defined cardinal area, perforated hinge plate and narrow elongate muscle area divided by a faint median septum.

We have spoken elsewhere of the relations of this and similar shells to Trigeria and of the presence of such forms both in the Oriskany and Helderberg faunas. We have identified in the Cumberland Oriskany, Trigeria gaudryi OEhlert [*see* Palaeontology of New York, v. 8, pt 2, pl. 76, fig. 6, 7] and T. portlandica Billings from Square Lake, Me. is a somewhat similar shell. Both however lack the specific characters of the shell before us.

*Horizon.* Very abundant in nos. 11, 13.

### Sieberella pseudogaleata Hall

Plate 7, figures 24–26

Pentamerus pseudogaleatus Hall. Palaeontology of New York. 1859. 3: 259, pl. 48, fig. 2 a–i

Sieberella pseudogaleata Hall & Clarke. *op. cit.* v. 8, pt 2, pl. 72, fig. 14

Specimens of this Helderbergian species abound in the lowest beds of the series though very seldom well preserved.

*Horizon.* No. 1.

### Camarotoechia

The species present at Dalhousie are poorly preserved, being badly crushed and it is not easy to arrive at a satisfactory conclusion as to their affinities. Two at least are present, one a coarsely plicated shell with a few ribs, three in the sinus, all bearing very strong imbricating, concentric growth lines and presenting an unfamiliar aspect. Another suggests C. formosa Hall — a Helderberg species.

### Spirifer concinnus Hall

Plate 8, figures 1–16

Spirifer concinnus was described and fully illustrated by Hall in the *Palaeontology of New York* [1859. 3: 200, pl. 25, fig. 2 a-i ; pl. 28, fig. 7] and is one of the common species of the Helderberg (New Scotland) fauna. It has certain well defined differentials: a low broad median sinus and prominent fold, prominent ventral beak and area, linguate anterior extension of the sinus, full umbones in both valves, a rather elongate outline fore and aft, 6 to 7 rounded ribs on each lateral slope and the surface covered with fine, sharp, crowded and elevated concentric striae which have been described as granulose on the edges but which are really fimbriate with a single row of minute spinules.

The most abundant spirifer at Dalhousie is of this type and is doubt-

less S. concinnus, quite uniformly varying however in the overarching of the ventral cardinal area which brings the beaks into close apposition. The preservation of these is such as to bring out more completely than before known the precise character of the surface and furthermore the fact that the surface of the ventral cardinal area when well retained shows the peculiar twilled marking which has been observed on the exterior of shells of Syringothyris. This sculpture is actually a series of extremely fine wavy lines traversing the area obliquely subparallel to the margins of the delthyrium. It proves to be present on New York specimens also. When Hall described this species he referred to an occasional specimen showing indications of accessory plications on the anterior portion of fold and sinus. Such a specimen was figured in volume 8, *Palaeontology of New York*, part 2. This unusual and abnormal occurrence gives a very false conception of the relations of the species and has already been sufficiently misleading [*op. cit.*]. Nothing of this sort has been observed in the Dalhousie shells and in the New York shells only with the greatest rarity. It is well to note that Spirifer concinnus is very closely approached by some of the shells included by Schnur under the designation S. undiferus F. Roemer and these Scupin has identified as S. gerolsteinensis Steininger [*see* Paläontol. Abhandl. 1900, pl. 5, fig. 14].

*Horizon.* Nos. 1, 2, 8, 9, 10.

### Spirifer perlamellosus Hall

Plate 8, figures 17-20

*See* pt 1, p. 110

Spirifer perlamellosus Hall? Palaeontology of New York. 1859. 3: 201, pl. 26, fig. 1, 2

Spirifer perlamellosus Hall & Clarke. *op. cit.* v. 8, pt 2, pl. 35, fig. 7-13

This characteristic species of the Helderbergian fauna in New York is well expressed in the Dalhousie beds. Correspondence in details of structure is shown throughout and specially pronounced in the latter is the striation of the concentric lamellae. This feature carries no collateral evidence of fimbriae though it may possibly imply such structure. This evidence is in accordance with our observation made in the second of the works above cited [p. 17].

*Horizon.* Nos. 8, 9.

### Cyrtina chalazia Clarke

Plate 7, figures 27-32

Cyrtina chalazia Clarke. N. Y. State Mus. Bul. 107. 1907. p.262

We are presented in these shells with a departure from the usual aspect of the Devonic Cyrtinas. They are mostly multiplicate shells and in the early stages of this time conform quite generally to the same expression in

contour, size and ribbing. Here we have a pauciplicate shell, the dorsal valve of which presents the characters which we have noticed as a feature of Spirifer plicatus Weller of the Grande Grève limestones; few, broad and blunt ribs. The shells are of the small size quite characteristic of the genus with trihedral form and erect or but very slightly curved cardinal area, flat dorsal valve, median sinus and fold well developed, the former having the width of the next two adjoining lateral plications. There are four to five plications on each ventrolateral slope and three to four on the dorsal, the ones nearest the hinge being always very faint. These are in the main broad and smooth, and concentric growth lines are usually crowded near the front margin.

*Horizon.* No. 9.

### Meristella princeps Hall

Merista (Meristella) princeps Hall. Palaeontology of New York. 1859. 3:251, pl. 44, fig. 1-5

Occasionally in this fauna

*Horizon.* Nos. 1, 11.

### Nucleospira concentrica Hall

Nucleospira concentrica Hall. Palaeontology of New York. 1859. 3:223 pl. 28 B, fig. 15-19

This species, common in the Helderberg fauna, is occasional at Dalhousie.

*Horizon.* No. 9.

### Trematospira perforata Hall var. atlantica Clarke

Plate 7, figures 21-23

Trematospira perforata Hall var. atlantica Clarke. N. Y. State Mus. Bul. 107. 1907. p.262

Species of Trematospira are almost exclusively of Helderbergian age and the species described are pretty well defined on the basis of their sculpture. In the form before us we have one more nearly allied in this respect to T. perforata Hall than to any other, though it differs substantially even from that. This shell has the following characters: The ventral sinus is not bounded by the median primary pair of plications but by the pair just outside the median, the latter in later growth making a pair on the sloping walls of the sinus. Likewise the median rib on the dorsal valve, while constituting the crest of the median fold is accompanied by a pair of ribs of primary age which modify the slopes of the fold. At the beak and continuing for one third the length of the shell without modification the number of plications on the ventral valve is 12, on the dorsal

valve 11. From this point outward the ribs irregularly dichotomize each into two or sometimes three, fold and sinus being affected like the rest of the surface.

The shell is transverse with straight hinge and without cardinal areas. The ventral beak is abruptly perforate and the shell substance punctate.

*Horizon.* No. 9.

### Atrypa reticularis Linné

Very abundant and without variation from the Helderbergian type.

*Horizon.* Nos. 8, 10, 11.

### Stropheodonta

It is quite clear that the Stropheodontas of the Helderbergian fauna find their origin in the stock of that variable, unstable and shifty shell whose protean expressions have been usually embraced under the name Stropheodonta varistriata Conrad, occurring in the Tentaculite or Manlius limestone of New York and passing upward into the Coeymans limestone of the Helderbergian. We have already had occasion to refer to this species. It is first, a Brachyprion in the sense that its row of cardinal denticulations does not extend far from the delthyrium; secondly, its surface may be either coarsely ribbed, finely ribbed and fasciculate or, with the last condition, puckered or undulated. All these expressions have been shown in accounts of the shell [*see* Palaeontology of New York, v. 8, pt 2, pl. 13, fig. 6–16]. These differences are thus accounted for: the coarse plication is the perdurance to maturity of a primitive condition not modified in later life; the condition of finer plication results from an acceleration of intercalation of plications; fasciculation follows, or in senile instances may precede this multiplicate condition. Undulation of interspaces follows the initiation of the fasciculate stage. The relative time of appearance of these features will depend wholly on the degree of acceleration or retardation in ontogeny.

The specific name S. varistriata now stands for a series of small shells with these variable expressions. Occasionally these are doubtless adults, never attaining large growth as in the Manlius limestone. In the faunas of next later date, however, all young forms of the regular or normal Stropheodontas are S. varistriata of one type or another, or to put the case conversely, those Stropheodontas can be traced by the surface markings on the adult shell, back from their mature stages whatever these may be, to one or another of the primitive expressions of S. varistriata. But in any such fauna, when all specific identities of mature forms have been eliminated there remain behind series of younger shells of variously progressed conditions which are not always readily assigned to their proper so called species. We have observed this in the Helderberg,

the St Alban and Grande Grève faunas and it is emphatically true again of the Dalhousie fauna.

Stropheodonta (Brachyprion) major, S. (B.) schuchertana and S. patersoni protype bonamica work back upon analysis to differently progressed expressions of S. varistriata; the first is a fasciculate shell in later stages, the second a finely plicate, nonfasciculate shell and the third both fasciculate and undulate.

Photo. by Charles Schuchert

Shore section of Dalhousie beds, divisions 11, 12, 13, Stewart's cove

**Stropheodonta varistriata** Conrad

Plate 8, figures 21–24

Some of the expressions of this shell are here represented. They show very much the same individual differences as are found in and have been illustrated from the New York shell.

*Horizon.* Nos. 8, 9.

## Stropheodonta patersoni Hall protype bonamica Clarke

Plate 9, figures 1–6

*See* pt 1, p. 186

Stropheodonta patersoni Hall protype bonamica Clarke. N. Y. State Mus. Bul. 107. 1907. p.270

We have noted on a previous occasion the difference in the Grande Grève form of S. patersoni and the typical expression of the species in the Onondaga limestone of New York. In the shell before us we have a quite different expression of this type, rare in American waters. The type itself, we may briefly reiterate, is expressed in the highly convex form, the strong fasciculation of the striae and the corrugation of the umbonal portion of the valves. We are here presented with a relatively small and quite narrow shell with a short, straight hinge, prominent cardinal extremities, highly convex or gibbous curvature (ventral valve) and greatly produced anterior margin. These are distinctly mutational characters which constitute very notable differences in the shells. The surface characters are more distinctly indicative of progressional phases of development and may be thus tabulated for the three different expressions of the species:

| | |
|---|---|
| Primary fascicles at the beak - - - | 19–25 patersoni<br>10–14 precedens, bonamica |
| Intercalation of the striae apicad of summit | frequent — precedens<br>less frequent — patersoni<br>occasional — bonamica |
| Anterior slope | finely and subequally lobed — patersoni, precedens<br>coarsely and strongly fasciculate — bonamica |

The umbonal corrugation appears to be differently developed according to individuals, but is generally coarsest in precedens, smaller and more numerous in patersoni. The summarized evidence indicates the phylogenetic relation of these species to be thus: bonamica retains the most primitive expression throughout supplemented by the character of its hinge which is denticulate only near the delthyrium; precedens is still more primitive than patersoni in respect to striation, but less so than bonamica. The relation indicated seems to be in accordance with the actual time relations of these shells.

Students of the Brachiopoda recognize in the fasciculate-crenulate type of surface structure a recrudescence in these early Devonic shells of characters which appeared among the Strophomenoids in the Lower Siluric and except for the corrugation became prevalent. This later expression is never common nor did it last long. The typical S. (Orthis) interstriatus Phillips is shown by Davidson[1] to carry at times the umbonal corrugations

[1] Monogr. Brach. 85, pl. 18, fig. 15–18.

and the large and fine S. nobilis McCoy[1] exemplifies both characters in very simple expression, both of these species being recognized as of Middle Devonic age. The former species is commonly regarded as present in the Eifelian.

*Horizon.* Nos. 8, 9.

### Stropheodonta (Brachyprion) major Clarke

Plate 9, figures 13–15

*See* pt 1, p. 190

Brachyprion majus Clarke. N. Y. State Mus. Mem. 3. 1900. p.54, pl. 8, fig. 8–13

This species, described from the Oriskany horizon at Becraft mountain, N. Y., is common at Dalhousie. It has the fasciculate arrangement of the striae fully expressed at an early growth stage and on to maturity.

*Horizon.* Nos. 1, 8, 9.

### Stropheodonta (Brachyprion) schuchertana Clarke

Plate 9, figures 7–12

Brachyprion schuchertanum Clarke. N. Y. State Mus. Mem. 3. 1900. p.56, pl. 8, fig. 1–7

This was also described from the Oriskany of eastern New York and is one of the commonest of the brachiopods at Dalhousie.

*Horizon.* Nos. 1, 8, 9.

### Strophonella punctulifera (Conrad)

Plate 9, figures 16–18

*See* pt 1, p. 111

The specimens of this species seem to be in complete agreement with those of the New York Helderbergian and of the St Alban beds of Gaspé. If there is a noteworthy feature of difference it lies in the unusual width of the cardinal areas of the two valves. In surface characters it approaches the form we have designated, S. continens var. equiplicata, from the Grande Grève limestone, a member of a series whose derivation does not bring it into immediate affinity to S. punctulifera.

*Horizon.* Nos. 1, 8, 9.

### Leptaena rhomboidalis Wilckens

Plate 10, figures 1–6

*See* pt 1, p. 183

Of the expression of the Helderbergian shell. Extraordinarily abundant in the upper layers of the section, exhibiting the pink tint of the shell

[1] *Idem*, p.86, pl. 18, fig. 19–21.

substance which so frequently characterizes this species under certain conditions of weathering.

*Horizon.* Nos. 1, 8, 9.

### Leptostrophia becki Hall

*See* pt 1, p. 111

Stropheodonta beckii Hall. Palaeontology of New York. 1859. 3: 191, pl. 22, fig. 1 a–t

Specimens of this species in this fauna apparently agree fully with those of the Helderbergian of New York.

*Horizon.* Nos. 8, 9, 11.

### Leptaenisca concava Hall

Plate 10, figures 7–11

Leptaena concava Hall. Palaeontology of New York. 1859. 3: 197, pl. 18, fig. 2
Leptaenisca concava Beecher. Am. Jour. Sci. 1890. 40:238, pl. 9, fig. 1–9
Leptaenisca concava Hall & Clarke. Palaeontology of New York. 1894. v. 8, pt 2, p. 300, pl. 15, fig. 30, 31; pl. 15A, fig. 19–21

When Beecher described the genus Leptaenisca there was but one species known, the L. concava of the Helderbergian. We subsequently described as additional species from the same fauna two smaller forms, L. adnascens and L. tangens [*op. cit.* 1894] which then seemed to differ from the larger both in form, surface sculpture and degree of attachment or size of cicatrix. We have before us in the Dalhousie fauna shells which at maturity present the characters of L. concava; their deeply convex and concave shells, with a cicatrix well developed, the form arched but frequently distorted in growth and some of these present a median flattening or sinus pretty well defined on the earlier portions of the ventral valves though this disappears in later growth. This median depression is one of the differentials of the smaller species L. tangens and L. adnascens and may indicate the possibility that the latter represent miniature conditions of L. concava. The presence of Leptaenisca concava in these beds is our first knowledge of the occurrence of the genus outside of the early Devonic of New York. The species are rare members of the Helderbergian fauna. At Dalhousie the shells are quite abundant.

*Horizon.* No. 1.

### Orthothetes (Schuchertella) radiatus Hall

Strophomena radiata Hall. Palaeontology of New York. 1859. 3: 191, pl. 21, fig. 8, 9

The Helderbergian species appears to be present at Dalhousie in normal development.

*Horizon.* No. 11.

### Schizophoria multistriata Hall

Plate 10, figures 12–18

Orthis multistriata Hall. Palaeontology of New York. 1859. 3: 176, pl. 15, fig. 2 a–t

Schizophoria multistriata Hall & Clarke. *op. cit.* v. 8. pt 1, p.212

The representatives of this species at Dalhousie are quite well defined but attain a uniformly and notably larger size than in the Helderberg of New York. It is a common shell, while in the New Scotland beds of New York it is rare.

*Horizon.* Nos. 1, 9.

### Rhipidomella hybridoides Clarke

Plate 10, figures 19–28

Rhipidomella hybridoides Clarke. N. Y. State Mus. Bul. 107. 1907. p.282

But for the extravagant size this shell attains at full growth it would be quite impracticable to distinguish it from American forms of Sowerby's well known Upper Siluric Orthis hybrida. In its immature stages it is essentially that shell; at full growth its characters have changed by progression and indicate thereby a Postsiluric age.

*Horizon.* No. 2.

### Rhipidomella numus Clarke

Plate 11, figures 1–12

Rhipidomella numus Clarke. N. Y. State Mus. Bul. 107. 1907. p.283

A shell directly comparable to R. (Orthis) oblata Hall of the Helderberg fauna, agreeing therewith in form and contour of valves though perhaps never attaining the size of that species. It differs therefrom: (1) in the slightly greater length of hinge, but principally (2) in the very much coarser and sparser plication of the surface. In R. oblata the radial striae are fine and crowded; in a typical example I find about 70 at a distance of 10 mm from the beak and at the anterior margin in a shell 32 mm long, 190. In the largest example of R. numus, 24 mm long, there are 40 at 10 mm from the beak, 106 at the margin. Thus there are practically two striae in R. oblata to every one in R. numus; those of the latter angular, multiplying rapidly. When compared with the rarer Helderberg species R. eminens, its plication is still much coarser, its hinge not so long and it lacks the elevated ventral beak of that shell.

The species is quite abundant.

*Horizon.* No. 9.

### Craniella agaricina Hall & Clarke

Crania agaricina Hall & Clarke. Palaeontology of New York. v. 8, pt 1, p.180, pl. 4H, fig. 2

This shell was described from the Helderberg fauna at Clarksville, N. Y. It occurs also at Dalhousie.

*Horizon.* No. 9.

### Crania

A smooth-shelled Crania occurs attached to specimens of Pterinea at no. 10.

### Pholidops ovatus Hall

Occasional at Dalhousie.

*Horizon.* Nos. 8, 9, 10.

### Orbiculoidea sp.

Plate 11, figures 13, 14

Valves of a rather large species attaining a diameter of as much as 30 mm occur not infrequently together with smaller shells presumably of the same species. The specific relations are not altogether certain. I recognize no species to which I should care to assign them.

*Horizon.* No. 11.

### Favosites hemisphaericus M.-E. & H.

Favosites hemisphaericus Milne-Edwards and Haime. Polypiers Fossiles. 1851. p.247

Favosites hemisphaericus Lambe. *op. cit.* p.11

This species is represented by a large majority of the specimens from Dalhousie including all those with small corallites up to a diameter of 2 mm. They are mostly of discoid and expanded shapes but also include hemispherical, conical, cylindrical and clavate colonies. In the size of the corallite, the size and arrangement of the pores and specially in the abundance of the squamulae, they fully agree with the careful description given by Rominger [1] and Lambe.

The squamulae and incomplete septa have been observed in both weathered specimens and polished sections. Rominger has observed that the tubes, for a certain part of their length, are intersected by single, straight diaphragms, without complication, and again, both above and below, are found divided by very irregularly interlacing compound septa, and these features are extremely well developed in our specimens. The parts with crowded squamulae form alternating concentric zones with those where the squamulae form regular, rather distant septa. In one weathered

[1] Geol. Sur. Michigan, Foss. Corals. 1876. p.26.

specimen the zones with distant tabulae have been removed, leaving galleries of the parts which have been made more compact by the abundant squamulae. The pores are mostly arranged in two rows on the sides of the corallites and provided with raised margins.

Favosites hemisphaericus is a widespread Onondaga limestone species.

Rominger *op. cit.* [p.20] has stated that Siluric Favosites differ from the Devonic species by invariably having single diaphragms, and by the spinular character of the radial crests, the Devonic forms having squamulae instead of spinules. This statement is corroborated by Lambe. In the Dalhousie fauna, however, we have these two types commingled; the form with the complete tabulae and septal spines (F. helderbergiae) is by far the rarer of the two and the form with the Devonic characters is the one prevailing. This fact demonstrates that mingling of the two groups of species of Favosites is possible around the boundary of the Siluric and Devonic.

*Horizon.* Nos. 1, 10, 16.

### Favosites helderbergiae Hall

*See* pt 1, p. 218

Favosites helderbergiae Hall. N. Y. State Mus. Rep't 26. 1874. p.111

Among the very abundant specimens of Favosites at this locality two types can be microscopically distinguished by the size of the corallites. That with the larger corallites may be readily assigned to the F. niagarensis-helderbergiae group. Mr Lambe has identified specimens from Dalhousie as F. niagarensis, stating that the difference between the latter and F. helderbergiae, as cited in *Palaeontology of New York*, volume 6, does not hold true and that the only difference between the two forms, which are unlike in the size of the corallites, character of spiniform septa and tabulae, appears to be in the shape of the coralla, which in F. niagarensis are spherical or clavate, and in the other species lenticular, depressed, rounded or hemispherical. The former is also said to have had a small basal attachment. Application of these criteria and a comparison of the Dalhousie specimens with our large series of sections of F. niagarensis and with the type of F. helderbergiae in the New York State collections have corroborated Mr Lambe's conclusions only in a general way.

It actually appears that only a few of the specimens, viz, those with the largest corallites (from 2 to 2.5 mm in diameter) have the internal structure of this niagarensis-helderbergiae group; all the others have a very different structure. The former and fewer are partly club-shaped and in part broadly expanded and would not furnish any specific character in their shape. In sections, further, the septal spines are not nearly so frequent as in typical F. niagarensis and are also noticeably smaller, so that they are difficult

of observation and apparently absent in the larger part of the corallum. This is never the condition in F. niagarensis, but it is in F. helderbergiae and to such a degree that Hall and Simpson entirely failed to notice them and the thin sections of F. helderbergiae in the New York State Museum show that these septal spines project above the walls of the corallites, more like fine granules than spines.

*Horizon.* Nos. 1, 10, 16.

### Halysites catenularius Lamarck

The specimens of Halysites at this locality show a circular section and much irregularity in the meshes. After comparison with Mr Lambe's distinctions in this species and its varieties we prefer to leave the Dalhousie specimens as above.

*Horizon.* Nos. 10, 16.

### Zaphrentis shumardi (M.-E. & H.) Lambe

*See* pt 1, p. 113

This is an extremely common coral at Dalhousie, and has been specially studied by Mr Lambe. We have observed its occurrence in the St Alban beds.

*Horizon.* Nos. 1, 10, 16.

A few other corals are recognizable in this fauna — a Syringopora, Aulopora and Zaphrentis (cf. roemeri Hall).

Specimens of Monticulipora are also not infrequent.

### Dictyonema cf. splendens Billings

*See* pt 1, p. 113

*Horizon.* No. 10.

### Hindia fibrosa F. Roemer (sp.)

Calamopora fibrosa F. Roemer (not Goldfuss). Silur. Fauna des westl. Tennessee. 1860. p.2, pl. 2, fig. 2

Astylospongia inornata Hall. N.Y. State Cab. Nat. Hist. 16th An. Rep't. 1863. p.69

Hindia sphaeroidalis Duncan. Ann. & Mag. Nat. Hist. 1879. 4:84, pl. 9

Hindia fibrosa (Roemer sp.) Hinde. Cat. Foss. Sponges Brit. Mus. 1883. p.37, pl. 13, fig. 1

Hindia sphaeroidalis Rauff. Palaeospongiologie. 1894. pt 1, p.335, pl. 15–17, fig. 1–4

Hindia sphaeroidalis, the genotype of Hindia, was described by Duncan from specimens obtained at Dalhousie. Rauff has elaborated the structure of the skeleton more fully than was done by either Duncan or Hinde, but his conception of the species value and construction of the name will not commend itself to a respect for rules of nomenclature. It is clear that the name of this fossil is Hindia fibrosa Roemer (sp.). Cala-

mopora fibrosa Goldfuss with which Roemer identified his specimens from Perry county, Tenn. is a monticuliporoid or at all events not a Hindia, but Roemer's fossils were Hindias and when this generic name was proposed by Duncan it was to a species which so far as all investigations show is in no wise distinct from Roemer's. The Astylospongia inornata Hall from the New Scotland and Port Ewen beds of the New York Helderbergian is the same organism and if scruples of any kind should prevent the use of the term fibrosa then Hall's specific name would have priority over Duncan's.

Rauff has brought together as this species ball-shaped sponges from a variety of geological horizons from the Trenton limestone upward to the Helderbergian. Hinde has shown the Helderberg forms from Dalhousie, New York and Tennessee to be of one species, but at present we have no reliable evidence that this species occurs below or above that horizon.

These bodies are extremely abundant at Dalhousie.

*Horizon.* Nos. 1, 8, 9.

### Supposed marine algae

Plate 11, figures 15, 13

Some of the layers at Dalhousie abound in bunches or tangles of fine black threads often branching from a central stock and sometimes associated with heavier stipes.

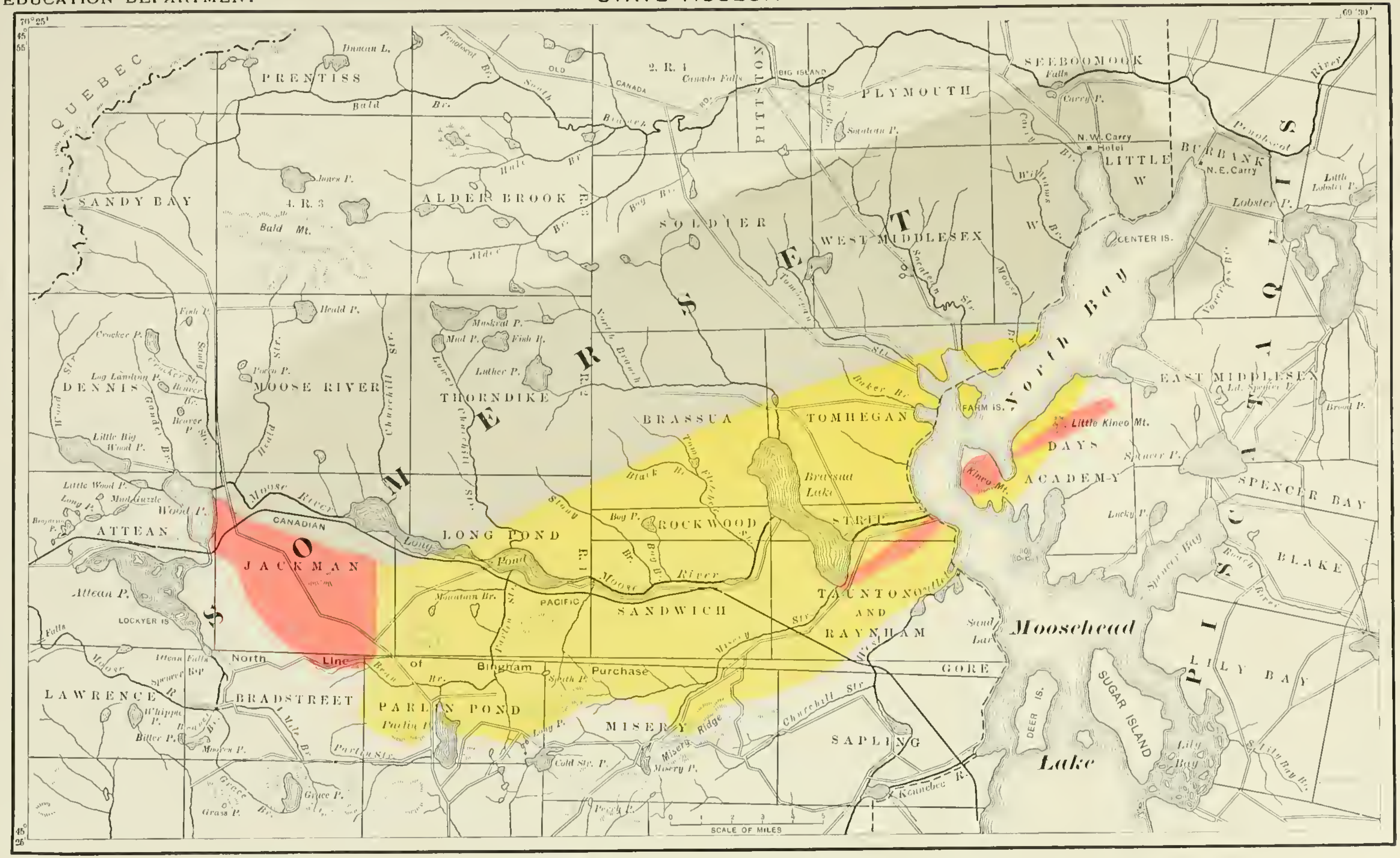
The chitinous matter of these bodies is thin and unsubstantial, too much so for graptolites nor do they show traces of thecae. They present certain suggestions of the *Gorgonia;* were they gorgonians there should be some evidence of a calcareous layer surrounding an interior chitinous axis but there is no distinction of parts in these frail bodies, and even though we might conceive the calcareous matter dissolved out yet the evident flexibility of these films, shown by the forms they have assumed under drifting, indicates an entire absence of the rigidity which characterizes the *Gorgonia* stem. With dissolution of the calcareous matter coralline algae might leave such tenuous brown films, and some of the recent Dasycladaceae would with the abstraction of their lime present such an aspect with the ramuli in verticils about a jointed shaft. These bodies do not distinctly show the jointing of the shaft though there are scars along the stems which indicate the attachment of deciduous branchlets. Some show clearly the arrangement of the branchlets in whorls. The presence of thicker and larger stocks among these drifted bodies seems also to suggest an algous nature. We have before made reference to a somewhat similar plant organism occurring in the St Alban beds and have quoted the judgment of Mr David White as to its probable nature. Here as there we may be dealing with objects ancestrally lepidodendroid but still unrevealed.

*Horizon.* No. 12.

## II

# THE ARENACEOUS DEVONIC FAUNAS OF SOMERSET, PISCATAQUIS AND PENOBSCOT COUNTIES, MAINE

It is the purpose of this chapter to set forth as adequately as our present knowledge permits, the fauna of the extensive band of arenaceous rocks in northern Maine which have usually been called the "Oriskany" in the few references which have been made to them. This band of sediments extends from central Somerset county on the west, northeasterly across Piscataquis and into the northwestern corner of Penobscot county, extending thence according to Professor C. H. Hitchcock's geological map of the State, a short distance into Aroostook county. These rocks were observed in the first geological survey of Maine by Dr C. T. Jackson and mention made of them in his annual reports [*see particularly* 3d Rep't. 1838. p.46, *et seq.*], but nothing can be derived from these reports that gives any clue to the actual position of the formation in the geological series. It is to Professor Hitchcock that we owe nearly all our knowledge of the formation hitherto published and yet it is more than 45 years since his official and very important report was issued. This report appeared as a part of the 6th annual report of the secretary of the Maine Board of Agriculture, 1861, and the description of the rocks with which we are here concerned is set forth particularly on pages 243–45; 400–12 and 441. This report was accompanied by a geological map bearing the date 1862 and showing the band of Oriskany sandstone as continuous across the area indicated. I shall here quote parts of this report as indicating the geological structure of the region. The same geologist subsequently issued a geological map of the state of Maine (1885) with brief explanatory text, The fossils collected by Professor Hitchcock during the period of his investigations were in part identified by Mr Billings whose determinations are cited in the report referred to and also appeared in the proceedings of the Portland Society of Natural History, volume 1, 1869, page 106. But from the statement made in the text accompanying the geological map of




PARTS OF SOMERSET AND PISCATAQUIS COUNTIES
SHOWING THE DISTRIBUTION OF THE MOOSE RIVER SANDSTONE

Igneous Rocks — Moose River Sandstone — Siluric Slates and Shale

1885 it would seem that all the material brought together from this formation by the Maine geologist was lost in the fire which destroyed the rooms of the Portland Society of Natural History in 1866. In 1899 a series of collections was made for the United States Geological Survey by Mr Gilbert van Ingen from the region west of Moosehead lake, that is, the westernmost portion of the area here considered. The results of van Ingen's collections and notes were briefly summarized by Professor H. S. Williams [U. S. Geol. Sur. Bul. 165, 1900, p.88–92] wherein are given sections at several localities, Parlin Pond, Jackman Farm, Bean Brook, Long Pond, Little Brassua lake, Stony Brook, Big Brassua lake, Brassua stream. The stratigraphy of some of these sections is indicated with as much detail as seemed practicable at most of the localities along this range of rocks and the sections or localities are in several instances accompanied by brief lists of fossils. We have been unable to acquire access to these collections and we shall therefore not attempt to comment upon the identifications of the species of the fossils there provisionally made. Professor Williams has discussed these sections under the term "Moose River sandstone" and it would seem entirely proper from the present state of our knowledge to apply this term to all the sections discussed in the present paper, that is to say, to practically the entire area of these rocks as indicated by Professor Hitchcock under the term "Oriskany sandstone." The fauna of these sandstones is a facies of the Eodevonic and represents the Oriskany [Williams, p.22].

Except then for the outlines of its geology and paleontology this very inviting region has remained almost a virgin field, and it was with the desire of enlarging our data as to the distribution of the early Devonic faunas in Eastern America that I arranged in 1905 with Mr O. O. Nylander to bring together with records of stratigraphic position as precise as possible, the fossils of these much folded rocks. Mr Nylander has done his work well though he did not attempt to cover the entire geographic area indicated on Hitchcock's map as pertaining to this formation. Outcrops especially favorable for the acquisition of the fossils were closely studied and the series of fossils obtained is large, quite sufficient to indicate the

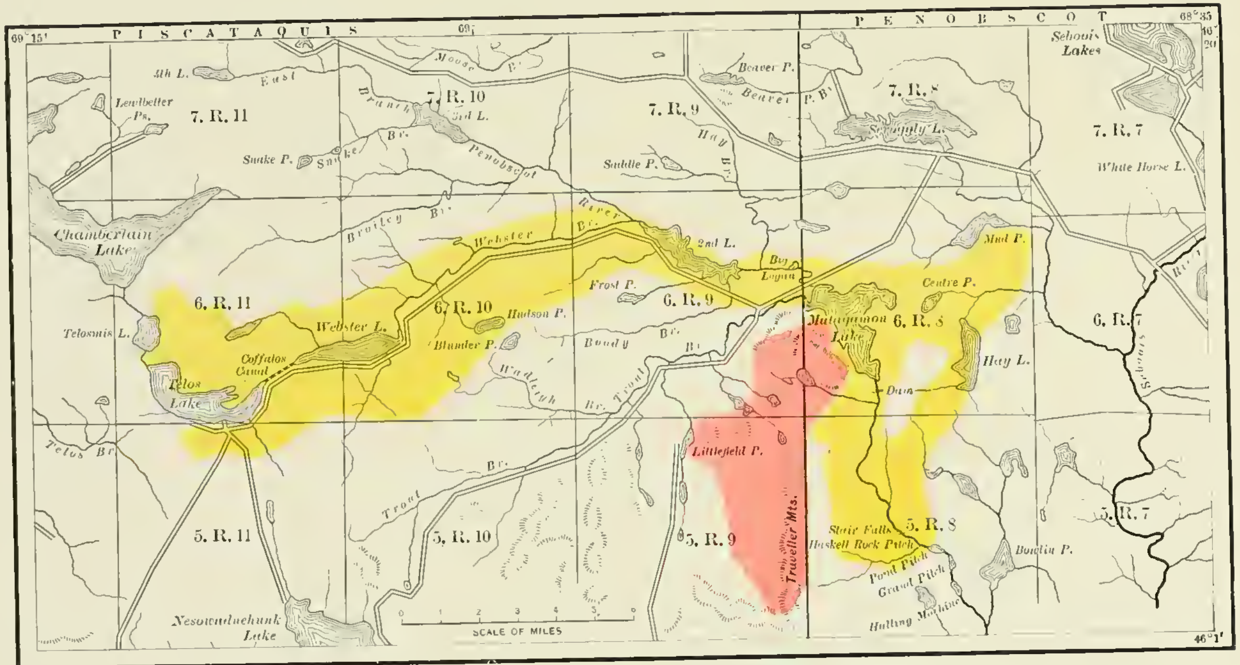
character of the fauna. An open and attractive field remains, however, for future workers and an increase in the census of the fauna is desirable and possible. The fossils here described and illustrated constitute the only accessible and established record of the species of these rocks.

*Stratigraphy.* The sandstones, conglomerates and arenaceous shales of this band of strata now included within the designation Moose River sandstone, are folded into low and much abraded anticlines generally having a northeast parallelism but much disturbed by breaking down along cross lines, so that an extreme irregularity of attitude is very noticeable in them. The homogeneous character of the sediments and their much disturbed condition combine to make it extremely difficult to unravel the actual succession of faunas. Indeed there is now no basis on which fully to establish any such difference of position in different members of the congeries here described and hence with our present knowledge we are compelled to assume the species here presented to be members of one fauna. In the absence of an exact knowledge of the stratigraphic and paleontologic succession, we nevertheless recognize certain differences in the local assemblages of fossils and this is brought out by the occurrence of a compact fauna carrying the species of the typical arenaceous Oriskany of central New York, such as Rensselaeria ovoides, Spirifer arenosus, Hipparionyx proximus and these occur together almost to the exclusion of the species elsewhere prevailing in the sandy shales.

Of the Oriskany sandstone of this region, Hitchcock has written as follows: [1861, p.243]

ORISKANY SANDSTONE

Although the Oriskany sandstone of Maine is wholly located in the wild lands, its general character and some of its fossils are better known than those of any other fossiliferous rock in the State; for by a wonderful agency of nature, to be presently described, fragments of this rock with fossils are scattered all over the settled districts, southeast of the rock in place. Boulders of these fossils have been found along the seacoast from Saco to Eastport, some of which have been carried over 150 miles. There is not a geological collection in the State in which specimens of these fossils are not found, and generally they are from boulders in the vicinity of the collection.




PARTS OF PISCATAQUIS AND PENOBSCOT COUNTIES
SHOWING THE DISTRIBUTION OF THE MOOSE RIVER SANDSTONE

Igneous Rocks

Moose River Sandstone

The material of the boulders is a very fine grained sandstone, or sometimes compact quartz rock, enabled to resist decomposition easily by its great toughness. So few fossils from other rocks may be found in boulders in the settled counties, that persons who find any fossils in their fields in loose fragments of rock, may be sure that they came from this belt of Oriskany sandstone.

Dr Jackson first pointed out the existence of this belt of fossiliferous rocks, without defining its position more definitely than the "Transition series," an old term nearly equivalent to the modern term Paleozoic. He discovered a fine locality of the fossils near Parlin Pond, in No. 3, R. 7, of Somerset county. The township is now called Parlin Pond. The following is his account of it: "Between Jackman's and Boise's farms, on the side of the [Canada] road, half a mile north of Parlin Pond, I discovered a huge bed of fine grauwacke, (a sandstone with argillaceous or talcose cement) filled with an immense number and variety of fossil shell impressions. The rock is of a fine siliceous variety, extremely compact where the shells do not abound, but presenting the most perfect casts of marine shells that I have ever seen. The width of the bed could not be exactly determined, as it is in part concealed by the soil; but I measured it for 50 rods, which is but a small part of its width. Among the fossils I obtained the following genera: terebratulae, spiriferae, lutrunae and turritellae, beside which there are several other indistinct or broken fossils, which it is more difficult to determine. From the direction of this rock, it evidently crosses Moose river and the head of Moosehead lake, and extends to the banks of the Aroostook [river], where we discovered it last year, and from it came all these numerous boulders and erratic blocks containing fossil shells, which we find scattered so profusely over the country, from the line above mentioned, to the outer islands of the Penobscot bay, and at the mouth of the Kennebec river."

Fossils from Parlin Pond and Moosehead lake were examined by Mr Billings, who reported as follows respecting them:

"The fossils from Parlin Pond belong to the following genera: Strophomena, Chonetes, Orthis, Rhynchonella, Rensselaeria, Leptocoelia, Spirifera, Modiolopsis, Cyrtodonta, Avicula, Murchisonia, Platyostoma, Orthoceras. The rocks are Lower Devonic, about the age of the Oriskany sandstone. The following are either identical or closely allied to Oriskany sandstone species:

| | |
|---|---|
| Strophomena magnifica * | Rensselaeria ovoides |
| Orthis musculosa | Leptocoelia flabellites |
| Rhynchonella oblata * | Spirifera arrecta * |
| Spirifera pyxeidata * | |

Those marked with an asterisk are considered to be either identical or closely allied species. Those not so marked are identical. The rocks at Moosehead lake are of the same age as the above. Leptocoelia

flabellites is very common among the specimens. The trilobite from Webster lake is a Dalmanites."

We have large collections of fossils from this sandstone on Lake Telos, Webster lake, etc., which were not seen by Mr Billings, and have not yet been determined. There are many genera among them not mentioned in the preceding list.

We need say no more respecting this Oriskany sandstone of Maine now, except to refer to its representation upon the map, extending from Parlin Pond to the Aroostook river in a general northeasterly course, and to the special details of the character and position of the rocks in Part II.

On later pages of this work, details of stratigraphy are given which it is not necessary here to quote as it has been the effort to revisit the majority of Hitchcock's localities for the purpose of the present investigations. It is interesting to note, however, Hitchcock's conclusions after a study of several sections in regard to the strike and dip of these beds; he says [p.402] speaking of the section along the east branch of the Penobscot river, near Matagamon lake: "It is difficult to ascertain the true position of this rock but we consider the following as the normal one: strike north 65° west; dip 45° north. The same layers are traversed by cleavage planes running north 18° east and inclined 83° east." This section evidently indicates a local departure from the attitude of the rock strata as a whole and some conception of the dislocation of these rocks is afforded by the series of variant dips recorded by Hitchcock on page 406, thus: "Just above Webster lake dam, the strata dip about 20° easterly. Then we soon pass an anticlinal as the next observation gives a westerly dip of 30° while the cleavage planes dip 75° southeast. Before reaching the west end of the lake the following are the positions of the strata in order: 5° east, 6° to 12° east, 20° west and 30° northwest, making two anticlinal and one synclinal axis on the lake." Evidence of similar character as to the folding of the strata is afforded by the dips and strikes recorded in the sections given herewith.

In a paper entitled "Geology of the Northwest Part of Maine" by Professor Hitchcock and J. H. Huntington [Am. Ass'n Adv. Sci. Proc. 1873] and in Hitchcock's final summary of the *Geology of Maine* accompanying his map of 1885, the known data in regard to the Oriskany sandstone have been summarized as follows:

*Oriskany sandstone.* This formation has a large development in the northern part of the State, extending from Parlin Pond across the northern end of Moosehead lake to Oxford Plantation. It may be several thousand feet thick, consisting of various sandstones and slaty rocks, the latter often exhibiting a cleavage at an angle with the strata. Parlin Pond shows the fossils in great profusion. From this belt there have been recognized Strophomena magnifica, S. rhomboidalis, Chonetes, Orthis musculosa, Rhynchonella oblata, Streptorhynchus radiata Van., Rensselaeria ovoides Hall, Leptocoelia flabellites, Spirifera arrecta, S. pyxidata, Leptodomus mainensis Billings, Platyostoma ventricosa Con., Modiolopsis, Cyrtodonta, Avicula, Murchisonia, Orthoceras, and Dalmanites. A fucoid allied to the Fucoides cauda-galli occurs on Moosehead lake. We have as yet few details of the distribution of the formation. It is best developed near Parlin Pond, the most southwestern exposure seen. The fossils were determined by E. Billings, of Montreal, P. Q.

Recent explorations have been directed towards the southwestern extremity of the terrace, as it points towards New Hampshire. The country between Moosehead lake and Parlin Pond, as well as that further southward, was traversed, and it was found that the Oriskany group, with a thickness of 2880 feet, rests against Eozoic gneisses and granites. Towards the southwestern end there were no indications of the passage of the sandstones into crystalline schists manifested. Hence two conclusions were derived from the facts observed:

1 The Oriskany sandstone reposes gently upon Eozoic gneisses — the first bearing scarcely more traces of alteration than the corresponding group in New York, while the second seems to have been metamorphosed and elevated before the Devonic formation was deposited. No further trace of this group has yet been found towards the White mountains. It has been followed through Maine from 150 to 200 miles, and similar rocks are described in Nova Scotia by Dawson. It can, therefore, no longer be maintained with reason that these strata pass into New Hampshire in a metamorphosed condition.

2 The Oriskany is several times thicker than in its extension in the interior and farther south in Pennsylvania. The greatest thickness mentioned by H. D. Rogers, is 520 feet, only one fifth its dimensions in Maine. The greatest observed thickness in New York is only 30 feet.

The enormous thickness ascribed to this series of arenaceous beds is entirely borne out by Mr Nylander's measurements and it appears that the basin in which these sediments have been deposited was bounded by very old strata extensively crystallized and to have had a much longer existence

as a basin of deposit than that in which the Oriskany of New York was laid down.

## SECTIONS

I give here in detail the stratigraphic sections adding thereto the lists of fossils as now known.

### Somerset county

#### *Moosehead lake*

Locality no. 3453 On the west side about 1 mile above the outlet of Moose river, a thick-bedded sandstone with quartz veins and distorted impressions of brachiopods and plants.

3454, 3455 South side of Baker Brook point fine grained sandstones, with strike e. 10° w., dip nearly vertical. Plant remains are common and the following invertebrates were taken :

| | |
|---|---|
| Dalmanites pleuroptyx | Spirifer perimele |
| Poleumita *sp.* | S. *nov.* |
| Prosocoelus pesanseris *var.* occidentalis | Chonetes hudsonicus |
| Modiomorpha odiata | Rhipidomella musculosa |
| Cypricardinia magna | Leptostrophia magnifica |
| Solenopsis | Megalanteris *cf.* ovalis |
| Spirifer primaevus atlanticus | Amphigenia parva |

Pholidops terminalis

3456 Farm island : at the south end shaly sandstone with a few much distorted fossils. From this point all along the shore to and on the east side of the island the rocks are better exposed than in any other part of the lake but on going north the layers are thicker with more quartz veins. In the Seventh Annual Report of the Maine Board of Agriculture, 1862 [p.331] is stated : "The most interesting thing discovered upon Farm island is a fossil plant allied to Fucoides cauda-galli." These markings have also been observed here by Mr Nylander.

3457 Tombegan Point, west side of lake: thick-bedded sandstones, strike e.-w., dip 30° n. A few fossils occur.

3458 Birch Point, ½ mile below outlet of Moose river; sandstones strike e. ne. 10° n. and contain a few brachiopods.

3459 Black Point; strike about same as foregoing. Some layers of the rock are full of Leptocoelia and can be traced for considerable distance into the clearing.

*Brassua lake, Moose river*

At the south end of lake are altered and volcanic rocks which extend through to Moosehead lake along what is called the Blue ridge and on the east side of Mount Kineo. On the west side of Brassua lake from Misery stream to the outlet, shaly sandstone outcrops at many places but no fossils have been observed.

3461 On the west shore above Moose river are loose blocks with some
3462 fossils and on the east shore opposite is a fine grained sandstone having a strike e. ne. and dip 80° n. nw., carrying Rhipi-
3463 domella musculosa. Just south of this point, sandstone blocks apparently in situ carry Rensselaeria in abundance and the rocks extending thence for a mile or more to the southeast carry the same fossils.

3464 Soccatean or Saccadean point: just to the north is dark shaly sandstone. Strike e. 15° n., dip 85° s. 10° e. These fossils were found:

| | |
|---|---|
| Cypricardella parmula | Cardiomorpha simplex |
| Palaeosolen simplex | Spirifer |
| Palaeosolen | Rensselaeria stewarti |

3465 Continuing northward along the shore for a quarter of a mile is quartzite overlain by a sandy shale showing decided change in attitude, striking ne. with a dip of 75° se. The continuation
3466 of this stretch of rocks emphasizes the variability of dip and the extreme folding and cleaving of the strata and also brings to
3467 light differences in the sediments which vary from a sandy shale often with many crushed and distorted fossils to compact
3468 sandstones of much thickness.

Just below the outlet of Moose brook is a prominent point of heavy sandstone with strata standing vertical. Here and on Moose Brook island adjoining fossils are common.

This is the last outcrop of these sandstones observed on the lake. Two miles north of Moose brook is an outcrop of slate representing an extensive belt exposed over the north reaches of the lake. It is impossible to state at present the relation of these slates to the sandstones as no fossils have been found in them.

### *Cuts on Canadian Pacific Railway and at Askwith siding*

3472 About 2 miles below Askwith siding are dark gray sandy shales bearing a strike of n. 60° e. and a dip of 80° n. 30° w. These contain distorted plants or worm burrows.

3473 Then follows a series of cuts through sandstones at various attitudes with mostly badly preserved Leptostrophia magnifica and Aviculopecten flammiger.

3474 At Misery Notch about $\frac{1}{4}$ mile below Asquith siding is an interesting anticline exposed in several sections by faulting and revealing a thickness of several hundred feet of the sandstone with great variation in the composition of the sediments. Fossils are scarce, only a few Rensselaerias in the topmost layers.

### *Misery stream*

A short distance beyond Asquith siding is Misery stream. From the railroad bridge to Brassua lake the sandstones outcrop in many places along the bottom of the stream for a distance of 3 miles but no fossils could be found.

3475 At the first dam in the town of Sandwich are exposed from the top downward

1 dark colored shale with some nodular masses, 40 feet

2 fine gray sandstone, 3 feet

3 dark shaly sandstone, 24 feet

4 hard compact gray sandstone, 12 feet

5 shaly gray sandstone of great thickness.

The strike of this section is e. ne., dip 40° s. se.

Fossils occur in several of these layers but in great abundance in no. 1, from which have been identified:

Rensselaeria callida
R. diania
Aviculopecten flammiger
Allerisma
Chonostrophia dawsoni
Chonetes canadensis
Chonetes nectus

Outcrops of shaly layers appear for at least 4 miles above this dam but fossils were not observed.

*Stony brook, Moose river*

3476 Sandstones with shaly layers are exposed across the bottom of Moose river and up Stony brook for a mile or more. The more shaly layers on the north bank of the river and in the brook contain fossils:

Aviculopecten flammiger
Chonetes hudsonicus
Chonetes nectus
Amphigenia parva
Rhipidomella musculosa

*Jackman and Parlin Pond*

Jackman farm is located on the Canada road at the extreme southeast corner of Jackman.

3477 Here are dark bluish gray shaly sandstones with a nearly n.-s. strike, dip e., in some places filled with plant fragments and a few other fossils.

Leptostrophia oriskania
Atrypa reticularis
Dalmanella *cf.* circularis
Leptocoelia flabellites
Megalanteris *cf.* ovalis
Meristella

The outcrop crosses the corner of Jackman and extends into the township of Parlin Pond for a half mile.

3478 North of Bean brook in Parlin Pond township on the Canada road are thick-bedded sandstones having a n.-s. strike and easterly dip. Here the following fossils were obtained:

Dalmanites pleuroptyx
Spirifer arenosus
Leptocoelia flabellites

3479 Just north of Parlin Pond on the west side of the Canada road are thick sandstones, recorded first by Dr Jackson. Fossils occur here but the outcrops are now unfavorable to examination and were visited at a disadvantage.

### Piscataquis county

3470 On the east side of Moosehead lake, southeast side of Kineo bay, is a shaly sandstone with a few fossils.

3471 Seven miles north of Kineo on the Folsom farm are large quantities of fossiliferous boulders, in part evidently derived from the greatly broken rocks beneath and in part from Soccatean point on the opposite side of the lake. The following species have been identified here:

Dalmanites pleuroptyx
Homalonotus vanuxemi
Pterinea mainensis
Aviculopecten alcis
A. *cf.* gebhardi
Palaeopinna flabellum
Cyrtodonta beyrichi
C. muscula
Tropidodiscus obex
Diaphorostoma ventricosum
Coelidium tenue
Spirifer cyclopterus
Chonetes impensus
Chonostrophia dawsoni
Leptostrophia oriskania

*Telosinis lake or Round pond*

Telosinis lake is the northern end of the more northern section here considered. It is the first of a chain of reservoirs running eastward from Chamberlain lake and lies about ½ mile west of Telos lake.

3436 At the entrance of the outlet eastward toward the latter is a series of rocky reefs extending for about 1 mile, the strike being e.-w. with a dip of 85° s.[1] Fossils not specially abundant; Leptocoelia flabellites, Rensselaeria ovoides, Platyceras sp.

*Telos lake*

Telos lake about 4½ miles long presents a series of interesting outcrops.

[1] The name of this lake is sometimes pronounced and written Telosmis. Professor Hitchcock overlooked these outcrops stating definitely that no rocks are exposed on this lake [Sixth An. Rep't Maine Bd Agric. 1861. p. 408].

3430 Two miles above Telos dam; thin-bedded sandstones, in part shaly in form of an anticline. In Blind Cove on the north side the strata present a strike sw.-ne., dip 15° se. No fossils found.

3431 Blind Cove point. The rocks are here anticlined with heavy sandstone at the axis. The thickness is estimated at 1500 to 2000 feet with strike n. 40° e. and dip very variable. The lower sandstones contain some plant remains, above them lying beds in which are Leptocoelia flabellites (extremely abundant), Leptostrophia oriskania, Orthothetes woolworthanus and Leptodomus prunus.

3432 A broken, badly sheared anticline ½ mile above Blind Cove point. Fossils few and poorly preserved.

3433 One mile above Blind Cove point. Rocks badly sheared and broken.

| | |
|---|---|
| Dalmanites pleuroptyx | Platyceras *sp.* |
| D. ploratus | Actinopteria textilis |
| Cornulites | Meristella |
| Diaphorostoma desmatum | |

3434 A point at the west end of the lake with thin-bedded sandstones having no fossils.

3435 Telos dam; from loose blocks the following were obtained: Leptocoelia flabellites, Megalanteris ovalis, Pterinea mainensis.

*Webster lake*

3437 At the upper end a broken ledge with few poorly preserved fossils (Leptocoelia).

3438–3438A On the north side ¼ mile from the inlet of Telos canal, dip 53° n.nw.

| | |
|---|---|
| Leptocoelia flabellites | Diaphorostoma ventricosum |
| Cyrtina affinis | Pterinea moneris |

3439–3440 The stretch below the preceding for about 1 mile shows three anticlines of beds without organic remains, the strata being badly cleaved to the Webster dam at the foot of the lake.

From Webster lake along Webster brook are a number of outcrops

without fossils, the strata belonging to the upper part of the series. Outcrops are also seen on Second lake. On the thoroughfare between Second and Matagamon lakes is a high bluff of shaly sandstone with a nw. strike and ne. 50° dip.

### Penobscot county

*Matagamon or Grand lake*

3442 Stump point on the west side, northeast of Matagamon mountain; thick-bedded sandstone, strike ne., dip 80° nw. bearing plant remains poorly preserved.

3443 A large block of sandstone not far from the preceding, lying in the strike of the plant beds and apparently not far from its original site afforded large quantities of

| | |
|---|---|
| Hipparionyx proximus | Rensselaeria ovoides |

3444 Matagamon lake dam, north side of river. Thick-bedded sandstone with

| | |
|---|---|
| Homalonotus vanuxemi | Tentaculites scalaris |
| Tropidodiscus *cf.* obex | Leptostrophia magnifica |

3445 South side of the same; calcareous concretionary sandstone with few fossils.

3446 This station number includes outcrops 1 mile above the dam on the east side of the lake where recent burning of the forest has exposed a large mass of fossiliferous rocks; also other outcrops on the shores and islands of the lake wherever fossils have been found. All these strata seem to pertain to the upper part of the series as expressed on Webster and Telos lakes, and they lie in a series of folds or dome-shaped anticlines.

| | |
|---|---|
| Homalonotus vanuxemi | Pterinea moneris |
| Tentaculites perceensis | P. *sp.* |
| Phragmostoma diopetes | Modiomorpha odiata |
| Plectonotus derbyi | Leptostrophia oriskania |
| Ditichia | L. magnifica |
| Pterinea radialis | |

*East branch of Penobscot river*

Below the dam at the outlet of Matagamon lake are many outcrops of thick-bedded sandstones.

3447 Is ½ mile below the dam on the west side of the river.

3448 Two miles below dam:

| | |
|---|---|
| Homalonotus vanuxemi | Tentaculites perceensis |

3449 Little Stair falls; no fossils.

3450 Stair falls, 5 miles below the lake; shaly sandstone; strike ne., dip 45° nw. Pterinea radialis and other fossils.

3451 Haskell Rock pitch ("Upper Falls" of Hitchcock).

Here a coarse conglomerate crosses the river and extends for ¼ mile. It has afforded no fossils. Professer Hitchcock makes the following comment: "This rock must be about 150 feet thick and is evidently the base of the following series of rocks to be described." (Oriskany sandstones)

3452 Fossils collected from loose blocks at Cunningham's camp, 4 miles southwest of Matagamon lake and 1 mile west of the river. This camp is in No. 5, R. 8, and appears to be practically the same place as that referred to by Hitchcock as "Johnston's camp," no longer known. Hitchcock characterized this as the "finest locality of Devonian fossils we have yet seen in Maine, but the ledges do not appear; the specimens are entirely loose fragments whose source must be very near" [p. 402]. Mr Nylander collected these species:

| | |
|---|---|
| Dalmanites pleuroptyx | Platyceras *cf.* calantica |
| D. ploratus | P. *sp.* |
| D. *sp.* | Pterinea radialis *var.* |
| Diaphorostoma desmatum | Palaeopinna flabellum |
| D. ventricosum | Spirifer arenosus |
| Cyrtolites expansus | Hipparionyx proximus |
| Plectonotus derbyi | Rensselaeria ovoides |

## DESCRIPTIONS OF SPECIES

### TRILOBITES

### Dalmanites pleuroptyx Green

Plate 12, figures 2-4

For references *see* Palaeontology of New York. 1888. 7:28

This characteristic species of the New Scotland limestone has not been seen in any other of the areas here discussed, its place apparently being taken by D. micrurus Green, a closely allied species whose differences from the former have been elsewhere indicated [*see* reference above]. We have here a fairly well preserved cephalon with the gently crenulated anterior margin of D. pleuroptyx though with somewhat longer head and not clearly defined anastomosing sulci on the free cheeks, in these respects like D. dolbeli of the Grande Grève limestone. There are present also pygidia which correspond quite fully with the typical form of the species, bearing 10 to 11 lateral sulcate ribs, 12 to 14 axial annulations and a short blunt caudal spine.

*Localities.* Telos lake, 1 mile above Blind Cove point; loose at Cunningham's camp, 4 miles southwest of Matagamon lake; Moosehead lake, at Baker Brook point, and on the Folsom farm about 7 miles north of Kineo; Parlin Pond, north of Bean Brook on the Canada road.

### Dalmanites ploratus Clarke

Plate 12, figure 5

Dalmanites ploratus Clarke. N. Y. State Mus. Bul. 107. 1907. p.161

There is a group of tuberculated dalmanites in the early Devonic rocks, embracing D. dentatus Barrett (which the ornament of the cephalon shows to be a Corycephalus), from the Port Jervis Oriskany, the allied D. bisignatus Clarke and D. phacoptyx H. & C. from the Becraft Mountain Oriskany. Of the last two the pygidium of the former is a shield of slender proportions with regularly spaced tubercles on the axis, in the other it is large and has coarse irregularly scattered tubercles. The pygidium before us is of the general type of D. bisignatus but is larger and considerably more segmented. Thus D. bisignatus has 7 to 8 pleural ribs while D. ploratus has 15 to 16, the former 10 to 12 axial rings, the latter 20 to 22. Notwithstanding this difference there is a similarity in the size and arrangement of the tubercles or granules; on the annulations there is a single row of four of which the middle ones are largest. Passing to the apex of the spindle this middle pair becomes more conspicuous by the disappearance of the others and thus there appears to be a double axial row of these pustules. On the pleurae they are scattered irregularly and faintly over the sulcate ribs. Our

specimens do not show whether or not the caudal extremity ends in a spine.

*Locality.* Loose at Cunningham's camp, 4 miles below Matagamon lake, Me.

### Dalmanites sp.

Plate 12, figure 7

A pygidium similar to those of D. pleuroptyx in character of segmentation but with the caudal end rounded and upturned.

*Locality.* Cunningham's camp, Matagamon lake.

### Dalmanites sp. nov.

Plate 12, figure 6

Represented by a single pygidium having 7 to 8 pleurae which are coarse, angulated and grooved and bear a sharp terete caudal spine. I am not acquainted with any described species having this expression.

*Locality.* Telos lake, 1 mile above Blind Cove point.

### Dalmanites sp.

Plate 12, figure 8

Still another species of the genus is indicated by a pygidium of relatively small size, terete axis, sparse rounded annulations, 7 to 8, broad and sharp but not extended caudal extremity.

*Locality.* Tomhegan point, Moosehead lake.

### Homalonotus cf. vanuxemi Hall

Plate 12, figure 1

*See* p. 95

Fragments of various parts of the test including the cephalon indicate the species cited.

*Localities.* Matagamon lake, at the dam and 1 mile above on the east side, also 2 miles below the lake on the Penobscot river; Moosehead lake, 7 miles north of Kineo.

### Cornulites sp.

Plate 12, figure 24

This is a singularly large, long, slender and irregular form of this genus, deeply and sharply annulated with subequidistant ridges and intermediate lines. No similar form is known to me.

*Locality.* Telos lake, 1 mile above Blind Cove point.

### Tentaculites leclercqius Clarke

*See* pt 1, p. 117, pl. 12, fig 5 7

These specimens are somewhat larger than those from Percé, and show the same essential characters, annulations of variable size, often large and at irregular intervals, with fine concentric lines on the interspaces.

*Localities.* Matagamon lake, at the dam and 1 mile above; 2 miles below the lake on the East Branch; Moosehead lake, at Birch point.

### Tentaculites scalaris Schlotheim

*See* p. 98

*Localities.* Matagamon lake, at the dam, north side; Parlin Pond, on west side of Canada road.

### Platyceras cf. calantica Hall and hebes Clarke

Plate 12, figures 22, 23

*See* p. 101 and P. calantica Hall. Palaeontology of New York. 1859. 3:328, pl. 52, fig. 1-5

This is a shell of robust form and minute spire or blunt apex, a rather unusual type which may be compared with the shells above cited, one from the New Scotland fauna of New York, the other from Aroostook county, Me.

*Locality.* Loose at Cunningham's camp, 4 miles southwest of Matagamon lake.

### Platyceras sp.

Examples of other species too ill preserved for identification indicate that the genus is well represented in these rocks.

*Localities.* Telos lake, 1 mile above Blind Cove point; loose at Cunningham's camp.

### Diaphorostoma desmatum Clarke

*See* pt 1, p. 149

Diaphorostoma desmatum Clarke. N. Y. State Mus. Mem. 3. 1900. p. 29, pl. 3, fig. 13-19

*Localities.* Same as the foregoing.

### Diaphorostoma ventricosum (Hall)

*See* pt 1, p. 149

Platyostoma ventricosum Hall. Palaeontology of New York. 1859. 3:469, pl. 112, fig. 1-10; 113, fig. 7, 8; 115, fig. 8

*Localities.* Webster lake, north side, 1/4 mile east of inlet of Telos canal; Cunningham's camp, 4 miles from Matagamon lake; Moosehead lake, 7 miles north of Kineo.

### Poleumita sp.

Represented by inferior specimens of shells with whorls finely costated by spiral riblets.

*Locality.* Moosehead lake; Baker Brook point.

### Coelidium sp. cf. tenue Clarke

*See* p. 23, 99

These specimens are referred with some doubt to the Aroostook county species. Though similar in form they are quite uniformly of larger size and seldom show any evidence of the slit band.

*Locality.* Moosehead lake, 7 miles north of Kineo.

### Tropidodiscus cf. obex Clarke

Plate 12, figures 20, 21

*See* p. 99

Specimens apparently of this species are present but too badly preserved to identify with security. For the most part they are somewhat larger than those from Edmunds Hill.

*Localities.* Matagamon lake dam, north side; Moosehead lake, 7 miles north of Kineo.

### Plectonotus derbyi Clarke

Plate 12, figures 17-19

*See* p. 98

These specimens are entirely comparable with those noted from Edmunds Hill, Aroostook county, agreeing with them in size, which seems to be uniformly below the adult size of the Brazilian specimens.

*Localities.* Matagamon lake, 1 mile above dam on the east side; Cunningham's camp.

### Cyrtolites expansus Hall

Plate 12, figures 14-16

Cyrtolites ? expansus Hall. Palaeontology of New York. 1859. 3:479, pl. 114, fig. 4, 5

Cyrtolites expansus Clarke. N. Y. State Mus. Mem. 3. 1900. p.28, pl. 3, p.20-23

Specimens of this species agree closely with those from Becraft mountain, N. Y., without attaining the dimensions represented in Hall's figures from specimens in the Oriskany of Albany and Schoharie counties.

*Locality.* Cunningham's camp, 4 miles southwest of Matagamon lake.

### Phragmostoma diopetes Clarke

Plate 12, figures 9–13

Phragmostoma diopetes Clarke. N. Y. State Mus. Bul. 107. 1907. p.192

A small bellerophontid with well developed slit band and apparently smooth surface save for regular concentric growth lines. The shell expands rapidly to an explanate mouth which involves the spire and forms a broad flat plate on the posterior region with the callus about the spire extending into the aperture, making a structure altogether similar to that of P. natator (Portage group), the type of the genus.

*Locality*. Matagamon lake, Me. ; on east side 1 mile above dam.

### Aviculopecten alcis Clarke

Plate 13, figure 5

Aviculopecten alcis Clarke. N. Y. State Mus. Bul. 107. 1907. p.195

Shell slightly oblique with anterior beak and short anterior wing. Hinge and posterior wing not extending as far back as the body outline. Curvature of the margin gently convex in front and anterolaterally, narrowed and slightly produced behind. Body of the shell gently convex; length and hight equal. Surface covered by fine radial riblets of unequal size, close together, generally with some tendency to fasciculation behind, fine and fainter and closely crowded in front. These are all crossed by very fine concentric lines and coarse concentric wrinkles which are quite irregularly spaced. This description is based wholly on a left valve to which it has seemed unsafe to refer any associated right valves. Though there are ribbed Aviculopectens in all the formations here brought under consideration I know none which agrees with or approaches this.

*Locality*. Moosehead lake, 7 miles north of Kineo, Me.

### Aviculopecten cf. gebhardi (Hall)

Plate 14, figures 8, 9

*See* Palaeontology of New York. 1859. 3: 466, pl. 110, fig. 1 ; pl. 111, fig. 2

This is a large Aviculopecten of which we have both valves in rather inferior preservation, but showing coarse radial ribs and having the outline and contour of the species cited, which is from the Oriskany of Schoharie.

*Locality*. Cunningham's camp.

### Aviculopecten flammiger Clarke

Plate 13, figures 1-4

Aviculopecten flammiger Clarke. N. Y. State Mus. Bul. 107. 1907. p.196

A shell of somewhat variable exterior which approaches in outline the Pterinopecten proteus Clarke of the Becraft Mountain Oriskany [*see* N. Y. State Mus. Mem. 3, p.32, pl. 4, fig. 7], but it is unlike that in exterior. The round subcircular shell is strongly radiated, the primary radii being sometimes coarse with broad fascicles of intermediate striae, sometimes finer and less distinctly fasciculate. In the number of these primary ribs there is the greatest variation. All are crossed by sharply elevated concentric striae. The anterior wing is deeply sulcate and sinuous, the posterior relatively large and with concentric striae only. Only left valves of this species have been observed and they are readily recognized in spite of their variable ornament.

*Locality.* Askwith siding, Canadian Pacific Railway; Misery stream, at the first dam in the town of Sandwich; Moose river on the north bank and along Stony creek; near Blind Cove point, Telos lake, Me.

### Pterinea mainensis Clarke

Plate 14, figures 3-7

Pterinea mainensis Clarke. N. Y. State Mus. Bul. 107. 1907. p.201

Shell often of large size, oblique, hinge considerably shorter than the full length of the valve. Anterior wing well developed, but slightly sloping at the hinge and set off from the shell body by a low broad sulcus. Posterior wing relatively short not reaching the posterolateral limit of the valve and sometimes not more than one half or two thirds this distance. Body of the valves depressed, not sharply set off from the wings; anterior outline at first direct, then inclining more or less rapidly backward and often extended at the posterolateral margin from which the retreat toward the posterior wing is abruptly oblique. The surface of the left valve is covered by fine radii, equal on the anterior slope but unequal on the posterior and showing a tendency to fasciculation. These are minutely cancellated by concentric lines which on the anterior slope and wing and on the posterior slope become prominent to the exclusion of the radii. The right valve is shallow, evenly depressed, with the radii along the crescence line stronger and more distant and the cancellating lines subdued.

The hinge is distinctly pterineoid, showing a doubly divided umbonal tooth, strong oblique posterior ridge and broad, striated ligament surface.

This shell, extraordinarily abundant at some localities, is readily recognized by its extremely fine radial surface markings accompanying unusual size.

*Locality.* Telos lake dam and Moosehead lake, 7 miles north of Kineo, Me.

### Pterinea radialis Clarke

Plate 13, figures 10, 11, 14; plate 14, figures 1, 2

*See* p. 103

Pterinea radialis Clarke. N. Y. State Mus. Bul. 107. 1907. p.207

The specimens of this species from central Maine are rather better preserved than those from Aroostook county and also afford series of growth stages which show that younger shells have all the characters of the Chapman sandstone specimens but these are accompanied by shells of larger growth in which the surface radii become somewhat diffuse over the pallial region. Attention is called to the excellent development of the hinge characters as shown in our drawings: in the left valve a multipartite umbonal tooth of 5 to 6 cusps and a strong posterior oblique ridge, both lying beneath a broad striated ligament area.[1]

*Localities.* Matagamon lake, on east side, 1 mile above the dam; Stair falls, 5 miles below Matagamon lake on east branch of Penobscot river; Cunningham's camp.

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[1] Several authors have endeavored to ascertain a dependable basis for the subdivision of the old genus Pterinea, but the writer's experience has gradually led to the conviction that Devonic species of what may broadly be termed *pterineoids*, assume with such ease slight variations in dentition and sculpture that the subsidiary terms already in vogue (e. g. Actinopteria Hall) have an elastic and uncertain value. In practice such terms of restriction are so difficult of use that the best way to avoid the extremes of too broad unification under one generic name and of too narrow subdivision into many seems to be the old method of grouping by approximate species characters. The difficulties in the practical application of such proposed subgeneric or generic divisions of Pterinea are indicated in the series of terms recently proposed by Williams [On the Revision of the Mollusk Genus Pterinea Goldfuss. U. S. Nat. Mus. Proc. Apr. 1908. 35: 83–90] for the species included within the genus by its founder, Goldfuss.

The species Pterinea radialis above mentioned was based on examples from the Chapman sandstone; subsequently larger examples of the same type of structure were found in the Moose River sandstone as here mentioned. While it may be that the latter should be regarded a distinct variety, Professor Williams finds, from differences of convexity, that the Chapman shells are of his proposed genus Actinopterella and the Moose River shells of his Follmannella (not Follmannella of Drevermann). In the illustration of the species given by me in Museum bulletin 107, page 207, both forms were shown. The process which resolves one species or at best two very closely allied species into two distinct genera, is difficult of adoption in so impressionable a group as this.

### Pterinea moneris Clarke

Plate 13, figures 6-9

Pterinea moneris Clarke. N. Y. State Mus. Bul. 107. 1907. p.202

Somewhat oblique valves with hinge line less than the greatest length, anterior beaks, and moderately developed posterior wing. The surface is depressed and entirely devoid of radial markings on either body or wing, thus only concentric lines or rough wrinkles are present.

The umbonal teeth are strongly developed in the left valve as a set of three oblique ridges, behind them being a strong oblique ridge. What may prove to be the right valve of the species has a more convex surface, strong anterior muscle scar and teeth to correspond with the sockets of the other valve.

This species is like but much more oblique than the P. follmanni Frech and P. laevis Goldfuss of the Coblentzian.

*Locality.* Webster lake, north side, ¼ mile east of Telos canal and Matagamon lake, on east side, 1 mile above dam, Me.

### Actinopteria textilis (Hall)

*See* pt 1, p. 156

The specimens thus referred are apparently without departure from the general expression of the shell as it occurs in the Helderbergian and the Grande Grève limestones. The posterior wing is sometimes radially marked and at others bears only concentric lamellae.

*Locality.* Telos lake, 1 mile above Blind Cove point.

### Cyrtodonta beyrichi Beushausen

Plate 15, figures 4-6

Cyrtodonta beyrichi Beushausen. Beitr. zur. Kenntn. d. Oberharzen Spiriferensandsteins. 1884. p.67, pl. 3, fig. 2, 3

Cyrtodonta beyrichi Beushausen. N. Y. State Mus. Bul. 107. 1907. p.214

I am disposed to refer to this species without much reservation certain subcircular shells of Paracyclaslike outline with quite convex surface, slightly depressed behind and faintly sinuous in front. In these the hinge has the structure of Cyrtodonta strongly developed — the curved double anterior teeth and the long lateral or posterior grooves and ridges. Beushausen's figures were made from internal casts but they display the general outline and size of those before us.

The genus Cyrtodonta has not been observed in the Devonic rocks of the Appalachian province and its occurrence in the eastern region is of decided interest. While these Devonic species seem to agree in hinge

structure with those which have been referred to the genus from the Lower Siluric yet it is possible that differences may be found and Beushausen's recognition of the validity of Cyrtodonta which has commonly been regarded a synonym of Conrad's term Cypricardites, has been indorsed by Ulrich [Pal. of Minn. 1897. 3:534] who has elaborately illustrated the Siluric species. Cyrtodonta beyrichi in Germany occurs in the Spiriferensandstein of the Hartz mountains at the Kahleberg.

*Locality.* Moosehead lake, 7 miles north of Kineo, Me.

### Cyrtodonta muscula Clarke

Plate 15, figures 1-3

Cyrtodonta muscula Clarke. N. Y. State Mus. Bul. 107. 1907. p.215

Much more elongate than the preceding, retaining the pterineoid form, narrow in front, widening backward and with a broad anterior sinus. Hinge as in the other species.

*Locality.* Moosehead lake, 7 miles north of Kineo, Me.

### Palaeopinna flabellum Hall

Plate 17, figures 5, 6

*See* pt 1, p. 159

This species, which we have already observed, is common at Grande Grève and in the lower limestones of the St Alban division at Cape Rosier cove, as well as occasional in the Oriskany of New York, from which it was described, occurs here in characteristic specimens.

*Localities.* On Moosehead lake, 7 miles north of Kineo and at Cunningham's camp, 4 miles from Matagamon lake.

### Modiomorpha odiata Clarke

Plate 15, figures 14, 15; plate 16, figures 1-5

Modiomorpha odiata Clarke. N. Y. State Mus. Bul. 107. 1907. p.218

Shells elongate, depressed, convex and of considerable size; beak at the anterior third, hinge short, anterior curvature relatively narrow, the valves widening backward in a low very broad curve, umbonal ridge low but clearly defined making a flat or depressed posterior slope and rather straight posterior margin. Length about twice the hight; actual length of a full sized example 60 mm, hight 35 mm. Surface with concentric lines only.

Casts of interiors show sharp triangular umbonal tooth and socket, a low posterior ridge and tooth, sharp muscle scars and pallial impressions.

This species is hardly to be brought into comparison with any elsewhere described in this work, those of Chapman Plantation and the Grande Grève

limestone being of different character and the genus not being well known in equivalent horizons of the New York province.

*Localities.* Moosehead lake, Baker Brook point; Matagamon lake, east side, 1 mile above dam.

### **Prosocoelus pes-anseris** Zeiler & Wirtgen var. **occidentalis** Clarke

Plate 16, figures 14, 15

Prosocoelus pes-anseris Zeiler & Wirtgen var. occidentalis Clarke. N. Y. State Mus. Bul. 107. 1907. p.223

The genus Prosocoelus was established by Keferstein in 1857 and was first applied to the species Grammysia pes-anseris Zeiler & Wirtgen[1] by Beushausen[2] and the latter author subsequently described several species from Coblentzian horizons. The hinge in the genus is characterized by its strong and large, curved, umbonal teeth, two in number, with the uppermost the larger, and in the left valve a small triangular anterior tooth; a broad ligament area with longitudinal groove. The exterior bears two or three strong divergent ridges. In P. pes-anseris these surface ridges have an extreme of development.

It is of extraordinary interest to find this genus, not before known outside the typical regions of the Coblentzian, present in the fauna of central Maine and by a species which bears so strong a resemblance to P. pes-anseris as to make comparison therewith more reasonable than with any other of the known forms.

The shells from this fauna are usually elongate, broader behind than in front, nearly twice as long as high, with two strongly defined radial ridges; the umbonal ridge separated from the median ridge by a moderately deep broadening groove and in front of this a depression bounded by a still lower sometimes quite vague elevation. Some of Beushausen's species of Prosocoelus, especially P. ellipticus (Schalke, Hartz) have much the outline and expression of this shell. There are specimens in our collections that indicate a more orbicular outline quite similar to that of P. orbicularis Beushausen.[3] Though one of these is figured [pl. 16, fig. 13], I am not altogether certain whether these represent the latter species or may be compressed specimens of the former. The evidence seems to favor the former view.

*Locality.* Tomhegan point, Moosehead lake, Me.

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[1] Singhofen. Jahrb. des Vereins für Naturkunde im Herzogthum Nassau. 1851. p.290.

[2] Beitr. zur. Kenntn. d. Oberharzer Spiriferensandsteins. 1884. p.109.

[3] *Ibid.* p.110, pl. 5, fig. 8.

## Leptodomus prunus Clarke

Plate 16, figure 6

Leptodomus prunus Clarke. N. Y. State Mus. Bul. 107. 1907. p.225

Elongate shells with anterior umbones and low cincture most distinct at the beaks. Surface quite evenly convex though the beaks are depressed. Umbonal ridge broad and ill defined. Ornament consisting of concentric ridges, sharp in the umbonal region and with closely crowded concentric lines between all, becoming obscure toward the margins. Length of each valve about twice the hight.

This species is distinguished from L. canadensis Billings of the Grande Grève limestone by its shallower cincture, but further knowledge of the species may show its very close relationship to L. striatulus F. Roemer of the upper Coblentzian. [For figures of the latter *see* Beushausen. *op. cit.* p.265, pl. 24, fig. 12–14]

*Locality.* Telos lake, Blind Cove point, Me.

## Cypricardinia magna Clarke
## or
## cf. crenistriata Sandberger

Plate 15, figures 12, 13

*See* Sandberger. Verstein. d. rhein. Schichtensystems. 1850–56. p.263, pl. 28, fig. 5
Beushausen. Lamellibr. d. rhein. Devon. 1895. p. 178, pl. 16, fig. 9–13
Cypricardinia magna Clarke or *cf.* crenistriata Sandberger. N. Y. State Mus. Bul. 107. 1907. p.229

Shell large for this genus, somewhat variable in outline but usually obliquely rhomboidal with very strong umbonal ridge, anterior beaks, very decided postumbonal slope which is deeply incurved, narrow anterior extremity widening backward. Hinge somewhat curved, shell extended behind, lower margin slightly incurved and sinuate. Length and greatest hight as six to five, actual length 30 mm, hight 25 mm. Some specimens are quite erect with the hight and length equal. Surface bearing strong, concentric, lamellose and quite regular sculpture, on which the finer ornamental lines occurring in many other species have not been retained.

This shell in its size and proportions is very closely like C. crenistriata as figured by Beushausen from the lower and upper Coblentzian of the Rhine. Species in the Grande Grève limestone (C. distincta Billings) attain its size and C. planulata Hall (Schoharie grit) has a similar contour but no other form than that above cited is known to us which approaches it both in size and contour.

*Locality.* Moosehead lake, Baker Brook point, Me.

## Cypricardella parmula Clarke

Plate 16, figures 9-11

Cypricardella parmula Clarke. N. Y. State Mus. Bul. 107. 1907. p.228

These are small shells of oval outline with an almost uniform convexity, beaks well toward the front and very low umbonal ridge. They are about one third longer than high and are especially noteworthy for the strong development of the umbonal teeth, which are slightly curved ridges, the median one much the strongest, bounded by deep sockets and a more subdued tooth above and below.

There are no Cypricardellas of this type in the New York faunas where they are chiefly characterized by sharp concentric lines and strong umbonal ridge. Such shells as these are however very closely similar to C. bicostata Krantz and C. elongata Beushausen,[1] especially to the former.

*Locality.* Moosehead lake, a little north of Soccatean point, Me.

## Palaeosolen simplex Maurer

Plate 17, figures 3, 4

*See* p. 111

Solen simplex Maurer. Fauna d. rechtsrhein. Unterdevon. 1886. p.18

Palaeosolen simplex Beushausen. Lamellibr. d. rhein. Devon. 1895. p.224, pl. 18, fig. 9, 10

Palaeosolen simplex Maurer. N. Y. State Mus. Bul. 107. 1907. p.235

We have already noted the probable presence of this species in the Chapman Plantation fauna. The specimens before us though not abundant in our collections seem to present no distinction from the lower Coblentzian shell referred to, and we are disposed to assign them to that species without further question.

*Localities.* Moosehead lake, a little north of Soccatean point; also on Presque Isle stream, Chapman Plantation, Me.

## Cardiomorpha (Goniophora ?) simplex Clarke

Plate 15, figures 7-11

Cardiomorpha (Goniophora?) simplex Clarke. N. Y. State Mus. Bul. 107. 1907. p.229

Shells elongate with anterior beaks; narrow in front, widening behind and with a very high and bluntly angular umbonal ridge behind which is an abrupt posterior slope and in front a well marked sinuosity or radial depression. The posterior extremity of the shell is quite narrow and subacute.

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[1] *See* Beushausen's figures, *op. cit.* pl. 11, fig. 5-14.

The hinge is well displayed in some specimens and is peculiar for its simplicity; there is a moderately broad, striated ligament area which widens slightly beneath the beaks but there is, under the most favorable preservation, no evidence whatever of the umbonal teeth which exist in the typical forms of Goniophora. Therefore the suggestion of relationship to that genus is wholly based on the general aspect of the exterior. The shell is generally about twice as long as high and many attain a length of 50 mm. Surface sculpture simple concentric lines. Beushausen referred to Cardiomorpha such toothless shells, including within his diagnosis a large variety of external expressions, among others, forms having this Goniophoralike exterior [*see especially* C. alata Sandb. in *op. cit.* p.223, pl. 25, fig. 15–17].

*Locality.* Moosehead lake, north of Soccatean point, Me.

### Solenopsis sp.

Plate 17, figures 1, 2

There are specimens present in these rocks which palpably pertain to this genus but are too incomplete for description though we have given a figure to illustrate their general character.

*Locality.* Moosehead lake, Baker Brook point.

### Ditichia cf. elliptica Maurer

Plate 16, figures 7, 8

*See* Cucullella elliptica Maurer. Fauna d. rechtsrhein. Unterdevon. 1886. p.15
Ditichia mira v. Sandberger. Neues Jahrb. f. Mineral. 1891. Bnd. 2, p.104
Cucullella elliptica Beushausen. Lamell. d. rhein. Devon. 1895. p.104, pl. 5, fig. 9–15

This shell, represented only by a few internal casts, presents rather the most extreme development attained in Palaeoneilo or Cucullella of the double muscular ridge on the basis of which the species C. elliptica Maurer was separated from Cucullella by Sandberger under the generic name above used. Beushausen has declined to employ the term on account of the various gradations shown by different species in the development of this structure but so close is the resemblance between the specimen here figured and those given by Beushausen of the species cited[1] that identity is well nigh evident.

Cucullella elliptica is a lower Coblentzian species.

*Locality.* Matagamon lake, east side, 1 mile above dam.

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[1] *Op. cit.* pl. 5, *see especially* fig. 12, 12A.

### Rensselaeria ovoides (Eaton)

Plate 17, figures 10–12

*See* pt 1, p. 164

The examples of this species have an expression common in smaller New York shells but approach the elongated narrow form of the var. g a s p e n s i s found in the Grande Grève limestones and Gaspé sandstones.

*Localities.* Loose at Cunningham's camp and at foot of Matagamon mountain.

### Rensselaeria cf. stewarti Clarke

Plate 18, figures 1 3

*See* p. 38

Another shell occurring at a different locality than the others seems to pertain to a distinct species so similar to that cited as to justify a provisional reference thereto. This is a persistently small shell with plications varying from 40 to 60 on each valve and has what the others do not possess, a well developed hinge plate and some evidence of ventral muscular scars.

*Locality.* Moosehead lake, north of Soccatean point.

### Rensselaeria callida Clarke

Plate 17, figures 13–17

R e n s s e l a e r i a c a l l i d a Clarke. N. Y. State Mus. Bul. 107. 1907. p.241

On other pages we have entered into some discussion of the species of Rensselaeria of Trigerialike form occurring in Aroostook county and at Dalhousie and have indicated their affinities with the Coblentzian species R. s t r i g i c e p s and R. c r a s s i c o s t a. We have before us now extensive representations of two additional species occurring in association which, while presenting some aspects of similarity to the species referred to (R. a t l a n t i c a and R. s t e w a r t i), are not in full agreement with them. One of these here designated as R. c a l l i d a occurs in various stages of growth but the adult form is of considerable size, attaining a length of 50 mm and upward. Its valves are full, convex with a tendency to gibbosity, the ventral valve being broadly and faintly keeled and the dorsal valve slightly flattened medially, the ventral umbo elevated and arching but not incurving over the other. The outline is quite regularly oval. Beneath the beak the incurvature shows no evidence of flattening into a cardinal area as in the species cited nor is there evidence of such area on the dorsal valve. There are a well defined foraminal opening and tube and the dental plates are considerably developed extending from one fourth to one fifth the length of the valve though without thickening. There is no impressed muscular scar and no thickening of the shells in the umbonal region. In the dorsal valve, though there is a median septum extending about one third

the length of the shell, there is no thickening at the beak and the hinge plate is so slender that we have been unable to make it out. All these details are in notable contrast to R. atlantica, R. stewarti and the Coblentzian species referred to.

They are in closer correspondence to the Helderberg species R. aequiradiata Hall and indicate, irrespective of their considerable size, an entirely primitive condition of development. The markings of the surface consist of simple rounded or slightly flattened plications seldom with concentric growth lines or other interruptions. There are about 50 of these simple plications on each valve, the number varying very little with size and age.

*Localities.* Misery stream, first dam in town of Sandwich; Brassua lake, opposite Moose river, Me.

### Rensselaeria diania Clarke

Plate 18, figures 4-6

Rensselaeria diania Clarke. N. Y. State Mus. Bul. 107. 1907. p.242

This species retains the contour and simple structure of R. callida but differs wholly in its exterior which carries 20 to 30 very coarse and broad, sometimes quite sharply keeled plications which meet in sharp interlocking angles at the edge. Its similarity to R. crassicosta Koch of the Siegen greywacke is undeniable, and we have introduced some figures of that shell for purposes of comparison.

*Locality.* Misery stream, first dam in town of Sandwich, Me.

### Rensselaeria cf. crassicosta Koch

Plate 17, figures 7-9

*See* Koch. Neues Jahrb. für Mineral. 1881. p.237, and other German authors
Rensselaeria cf. crassicosta Koch N. Y. State Mus. Bul. 107. 1907. p.243

There are a few shells of small size in a quartzite at the above cited locality which are coarse ribbed and hardly to be distinguished from specimens of R. crassicosta which I have received from Professor Kayser. The dorsal valves show a long and much thickened septum with a divided hinge plate.

R. crassicosta is from the Taunus quartzite and Siegen beds of the Coblentzian.

*Locality.* Misery stream, first dam in town of Sandwich, Me.

### Rensselaeria (Amphigenia) parva Clarke

Plate 18, figures 7-13

Rensselaeria (Amphigenia) parva Clarke N. Y. State Mus. Bul. 107. 1907. p.247

A small, sometimes quite elongate species often presenting the appearance of a miniature of A. elongata Conrad. In the ventral valve the median septum is strong and the spondylium well developed, the lateral surfaces of the bottom of the valve vascular or pitted. In the dorsal valve there is a large perforated hinge plate, the foramen apparently always open in contrast to the condition of old specimens of A. elongata. The external surface is marked by rather strong concentric lines with some radial lines along the middle of the valves.

*Localities.* Moose river at Stony brook, Tomhegan point, Moosehead lake, and just north of Soccatean point, Me.

### Megalanteris cf. ovalis Hall

Plate 18, figures 14-16

Fragments and incomplete casts show the presence of this genus but they are insufficient for safe identification.

*Localities.* Telos lake dam (3435); Moosehead lake, Baker Brook point; southeast corner of Jackman farm in township of Parlin Pond.

### Meristella sp.

Internal casts appear to represent a small variety of M. lata Hall and a second species whose affinities are not determinable.

*Localities.* Telos lake, 1 mile above Blind Cove point; Telos lake dam; Jackman farm.

### Atrypa reticularis (Linné)

The small and compact Helderbergian type occurs rarely at Jackman farm.

### Leptocoelia flabellites (Conrad)

Plate 20, figures 15-19

*See* pt 1, p. 174; pt 2, p. 142

This shell which is extremely abundant in certain localities is always small with pretty well marked fold and sinus, the former carrying two plications, there being two or three on each lateral slope. The shell does not attain the average size of the prevalent form in the New York Oriskany and is in notable contrast to the large individuals found in the Grande Grève limestone.

*Localities.* Webster lake, north side; Telos lake dam; Blind Cove point, Moosehead lake; outlet of Moose brook and Black point; Jackman farm, Jackman township; Parlin Pond township, north of Bean brook on the Canada road; Matagamon lake, east side, 1 mile above dam.

### Spirifer primaevus Steininger var. atlanticus Clarke

Plate 19, figures 5-12; plate 20, figures 6, 7

Spirifer primaevus Steininger var. atlanticus Clarke. N. Y. State Mus. Bul. 107. 1907. p.260

For comparison consult:

**Morris & Sharpe.** Geol. Soc. Quar. Jour. 1846. 2:276, pl. 11, fig. 3. (S. orbignyi)

**Steininger.** Geognos. Beschreib. der Eifel. 1853. p.72, pl. 6, fig. 1. (S. primaevus)

**Sharpe.** Geol. Soc. Lond. Trans. 1856. Ser. 2, 7:206, pl. 26, fig. 1, 2, 5. (S. antarcticus)

**Hall.** Palaeontology of New York. 1859. 3:422, pl. 97. (S. arrectus)

**Kayser.** Fauna der aeltest. Devon-Ablagerungen des Harzes. 1878. p.165, 168, pl. 22, 23, 35. (S. decheni, S. hercyniae, S. primaevus)

**Ulrich.** Neues Jahrb. fur Mineral. Beil. Bnd. 8. 1893. p.65, pl. 4, fig. 19, 20. (S. chuquisaca)

**Scupin.** Die Spiriferen Deutschlands. 1900. p.84-88, pl.8. (S. primaevus, S. fallax Giebel = S. decheni Kayser, S. hercyniae Giebel, S. hercyniae var. primaeviformis)

**Clarke.** N. Y. State Mus. Mem. 3. 1900. p.46, pl. 6, fig. 26, 30. (S. murchisoni Orbigny)

**Reed.** An. South African Mus. 1903. v. 4, pt 3, 7, p.180, pl. 22, fig. 4. (S. orbignyi Morris & Sharpe)

The identity of species in the group represented by S. arrectus (S. murchisoni) and S. primaevus, is involved with obscurities of a kind which seem to indicate that in the considerable variety of species names from many countries some are synonymous terms and the majority, perhaps all the rest, are local expressions. The general type of structure is that of a sparsely ribbed Spirifer with the plications usually broadly rounded, a prominent fold and sinus without plication in the latter, and the entire surface finely fimbriate. The interior of the ventral valve has a very strong muscular scar appearing in the cast as a sulcate cordiform prominence and the plications lose themselves posteriorly on account of umbonal thickening of the valve. The shells now before us from central Maine are identified as a variety of the widely diffused Coblentzian species S. primaevus, not because of structural resemblances that can be fixed upon from the descriptions given of that species and its close allies in the Coblentzian, S. decheni, S. hercyniae and its variety primaeviformis, but the determination is based on comparisons with specimens of these species from Stadtfeld, Kellerwald and elsewhere kindly supplied and identified by Prof. E. Kayser. These shells are of large size with subtriangular outline, the anterolateral margins being rather direct and not

convex. Usually they are of considerable length fore and aft, but specimens are found, showing no apparent distortion, that are quite narrow and elongate. The hinge is the longest measurement of the shell and the ribs number from 7 to 11 on each lateral slope, the smaller number prevailing in the usual preservation. It may be noted that the first pair of ribs bounding the sinus is the highest as this is in contrast to some specimens of the New York Oriskany classed as S. murchisoni, where the first pair is lower than the second. A comparison of these specimens with those referred to S. arrectus of the Oriskany by Hall and well illustrated in the work cited, shows that there is a close approach in structure among the larger forms of those. In a previous publication [N. Y. State Mus. Mem. *op. cit.*] I have referred to the probability that the S. murchisoni of the New York Oriskany is an unstable form putting on the aspect now of one and now of another species elsewhere localized. Scupin has with more detail pointed out this condition, suggesting that some of Hall's drawings are of forms equivalent to S. antarcticus, S. chuquisaca, S. orbignyi and S. capensis, from the Falkland Islands, Bolivia and South Africa and that others, principally the smaller forms, express the local value of S. murchisoni. There are excellent reasons for these views, and though shells like S. primaevus var. atlanticus are apparently absent from the New York province yet there is no wide divergence between them and the larger examples of S. murchisoni. It will be understood that a proper interpretation of the congeries passing as S. murchisoni in the Oriskany is possible only in terms of well defined localized expressions; at the same time as between the northern and southern species there are distinctive features in sculpture, S. antarcticus for example being a radiately striated shell and therefore not in harmony with the group of S. murchisoni which carries a fimbriate exterior. These differences the author has discussed elsewhere.

*Localities.* Abundant at Baker Brook and Tomhegan points, Moosehead lake, Me.

### Spirifer arenosus (Conrad)

Plate 19, figures 1-4

*See* pt 1, p. 179

Entirely characteristic examples of this species as it occurs in the Oriskany sandstone of central New York, though quite uniformly of smaller size, are very abundant at Cunningham's camp. In these sandstones the habit expressed in form and size is persistent in all specimens.

A smaller expression of the species occurs in the more compact sandstone in Parlin Pond township north of Bean brook.

### Spirifer perimele Clarke

Plate 18, figures 17-21

Spirifer perimele Clarke. N. Y. State Mus. Bul. 107. 1907. p.253

This is a shell, abundant though poorly preserved in some of the sandstone blocks, which I should identify with S. carinatus Schnur were it not for the presence of fine and crowded lamellae which cover the surface. S. carinatus has been often described and illustrated from the Coblentzian, most recently by Kayser in *Fauna des Hauptquartzits*, 1889, page 24, plates 1, 10, 14 and Scupin, *Die Spiriferen Deutschlands*, 1900, page 26, plates 2, 3. S. perimele is a shell of medium proportions with relatively narrow cardinal area extending to the full width of the shell; its fold and sinus are conspicuous and rounded, relatively narrow, the fold sometimes becoming angular near the front. There are 10 to 12 rounded, closely appressed plications on each lateral slope, with narrow intervals. The sculpture when well preserved, which is not often, consists of subequidistant concentric elevated lines without trace of radii or fimbriae. The interior of the ventral valve shows a narrow but rather long ovate muscle scar which is not deeply depressed and is bounded by short dental lamellae. Fuller description of the shell can not now be given but these features are sufficient to indicate a dissimilarity with any known American Spirifer of this horizon.

*Locality.* Moosehead lake, Tomhegan and Baker Brook points, Me.

### Spirifer cyclopterus Hall

*See* pt 1, p. 178

While identifications of the smaller fimbriate species of the early Devonic are confessedly obscure, I refer to this species certain shells having the general style and degree of plication, convexity etc. of this Helderbergian species. At the same time it is necessary to admit that distinctions between the forms referred to S. cyclopterus from Grande Grève, Percé, central Maine and New York, and the specimens passing as S. saffordi and Oriskany forms of S. fimbriatus, are slender and variable.

*Locality.* Moosehead lake, 7 miles north of Kineo.

### Spirifer

Of the other fimbriate Spirifers in these faunas there is abundance of obscure remains not well preserved and difficult of exact identification. All are small species and among them is recognizable the form which has already been indicated as S. saffordi in the Grande Grève fauna.

*Locality.* Telos lake dam.

A quite distinct species which I think will prove unlike any known to us is a somewhat larger and elongate narrow shell carrying six or seven ribs on each side. This very common form has an interior like that of old individuals of S. murchisoni, the umbonal parts being greatly thickened and pustulose while the muscle scar is very deep [pl. 20, fig. 8–14]. Except for the fimbriate surface this species is marvellously close in all points of structure to S. arduennensis Schnur of the Coblentzian.

*Localities.* Telos lake dam. Moosehead lake, 7 miles north of Kineo.

Still another form is indicated by valves of the size of S. concinnus but rather more convex [pl. 20, fig. 1–4].

*Locality.* Moosehead lake, just north of Soccatean point.

### Spirifer aroostookensis Clarke

Plate 20, figure 5

*See* p. 143, pl. 30, fig. 5, 9; pl. 34, fig. 6-16

This species is represented here only by a fragment which bears broad flat plications separated by very narrow sulci, the plications being themselves sometimes depressed and subsulcate. The fold and sinus are broad and free of ribs and there is no other surface sculpture save regular and faint growth lines. It seems identical with the shell occurring in Aroostook county and in greater abundance in the New York Oriskany.

*Locality.* Tomhegan point, Moosehead lake.

### Cyrtina affinis Billings

*Locality.* Webster lake, north side.

### Chonetes impensus Clarke

Plate 20, figure 29

Chonetes impensus Clarke. N. Y. State Mus. Bul. 107. 1907. p.263

A large shell having the aspect of Leptostrophia oriskania but with coarser striae. The single specimen of this species observed is a ventral valve, regularly convex, with very fine subequal striae for about one half its length followed beyond a distinct growth line by much coarser striae. The median stria on the early parts of the shell is larger than the rest. Hinge margin cornute. Hight 21 mm, length 28 mm. Specifically unlike any form known to the writer.

*Locality.* Moosehead lake, 7 miles north of Kineo bay, Me.

## Chonetes nectus Clarke

Plate 20, figures 22-25

Chonetes nectus Clarke. N. Y. State Mus. Bul. 107. 1907. p.263

A small coarse ribbed species, transversely elongate in form and having 14 to 16 striae, each of the larger of which is divided at variable distances from the middle to the margin of the valve. It is but slightly convex compared with C. hudsonicus Clarke and does not attain a length of more than 11 mm. A peculiar feature of the species is the general prevalence of a deep concentric constriction in the ventral valve which is present in every such valve yet recognized.

The interior of the dorsal valve is highly radio-pustulate, there being two strong central diverging ribs traversing the valve.

*Localities.* Misery stream, first dam in town of Sandwich; Moose river at Stony brook, Tomhegan point, Moosehead lake, Me.

## Chonetes (Eodevonaria) hudsonicus Clarke

Plate 20, figures 26-28

*See* pt 1, p. 238

The specimens of this species are highly characteristic varying in outline as do those of the Gaspé sandstone (var. gaspensis), some long and narrow, others broad, more nearly semicircular. In all, the singular row of hinge denticulations is highly developed.

*Localities.* Tomhegan point, Moosehead lake; Moose river at Stony brook.

## Chonetes canadensis Billings

Plate 21, figures 1-4

*See* pt 1, p. 235

The expressions of this remarkable species here appearing, elsewhere known only at Grande Grève and Percé, are in some respects extravagant. They do not always attain the maximum of size presented by the Percé examples but in them is carried to an extreme the development of the median internal septal ridge on the dorsal valve, which now becomes a sharp and elevated keel. The hinge sockets on this valve are greatly developed and produced, while the vascular sinuses with their intervening ridges are more pronounced than in any specimens we have elsewhere seen. The exterior of the ventral valve carries the characteristic median rib.

*Locality.* Misery stream, first dam in town of Sandwich.

### Chonostrophia dawsoni Billings

Plate 20, figures 30–33

*See* pt 1, p. 240

Comparison of the figures here given with those of C. dawsoni from the Gaspé sandstone and with C. complanata Hall will show clearly enough the similarity of these shells with the larger and broader forms which we recognize as pertaining to the former species. The shells under consideration have suffered slight distortion at times but this is in nowise such as to conceal their specific character.

*Localities.* Misery stream, first dam in town of Sandwich; 7 miles north of Kineo, Moosehead lake.

### Orthothetes (Schuchertella) woolworthanus Hall

*See* pt 1, p. 112

Some of the examples of this shell show the elongated form which has been rarely observed outside of the New York Helderbergian. [*See* Palaeontology of New York, v. 3, pl. 17, fig. 1i, 1m, 10, 2b]

*Locality.* Blind Cove point, Telos lake.

### Leptaena rhomboidalis (Wilckens) var. ventricosa Hall

Plate 21, figure 17

This very characteristic Oriskany shell is well represented.

*Locality.* Stony brook, Moose river, Me.

### Leptostrophia magnifica Hall

Plate 20, figures 20, 21; plate 21, figures 15, 16

*See* pt 1, p. 190

The shells of this species are highly characteristic often attaining the full size present in the Oriskany of New York and the limestones of Grande Grève. The predominant numbers however are smaller and there is a notable variation in outline with a tendency to an elongate form. It is extremely abundant in places.

*Localities.* Matagamon lake, at the dam and about 1 mile above; Moosehead lake at Baker Brook point; Askwith siding, Canadian Pacific Railway.

### Leptostrophia oriskania Clarke

Plate 21, figures 13, 14

*See* pt 1, p. 194

The specimens of these shells here occurring are all in agreement with the type as to size and structure but they are entirely free from such corrugations as appear occasionally in the Becraft Mountain Oriskany and frequently

in the Grande Grève specimens. They might in this respect be regarded as constituting a stable expression of the species of which the corrugated form is a variety. It is to be noted, however, that corrugation is often an incipient condition disappearing in late growth, and that hence the uncorrugated form is tachygenic. The shell is very common at certain localities.

*Localities.* Matagamon lake, east side, 1 mile above dam; Telos lake, Blind Cove point; Moosehead lake, 7 miles north of Kineo · Jackman farm.

### **Hipparionyx proximus** Vanuxem

Plate 21, figure 12

*See* pt 1, p. 200

The specimens of this highly characteristic Oriskany species are altogether like those occurring in the sands of New York and the limestones of the Forillon, Gaspé, though to our observation never attaining so large size.

*Localities.* Matagamon lake, northeast of Matagamon mountain; Cunningham's camp, 4 miles from Matagamon lake.

### **Rhipidomella musculosa** Hall var. **solaris** Clarke

Plate 21, figures 8-11

*See* pt 1, p. 201

Rhipidomella musculosa Hall var. solaris Clarke. N. Y. State Mus. Bul. 107. 1907. p.284

These are all small shells with the enormous adductor scar in a state of high development. The shells are somewhat less circular, more transverse than in the New York and Grande Grève Oriskany specimens of R. musculosa, but their specific identity is not greatly veiled.

*Localities.* Moosehead lake, Baker Brook point; Brassua lake, east side; Moose river at Stony brook, Me.

### **Dalmanella** cf. **circularis** (Sowerby)

Plate 21, figures 5-7

We have here some well defined internal casts of both valves of a plano-convex species. I do not attempt to further identify them than to institute the above comparison which may be extended to D. planoconvexa Hall of the Helderbergian.

*Locality.* Jackman farm.

### **Pholidops terminalis** Hall

*See* pt 1, p. 213

Occasional at Baker Brook point: Moosehead lake.

**DISTRIBUTION OF THE MOOSE RIVER FAUNA**

x = identity, + = affine

| SPECIES | Helderberg, N. Y. | Oriskany, N. Y. | Grande Grève, Gaspé | Chapman | Dalhousie | Coblentzian |
|---|---|---|---|---|---|---|
| Dalmanites pleuroptyx *Green* | x | | | | | |
| D. ploratus *Clarke* | | + | | | | |
| D. *sp* | | | | | | |
| D. *sp. n* | | | | | | |
| D. *sp* | | | | | | |
| Homalonotus *cf.* vanuxemi *Hall* | x | | | x | | |
| Cornulites *sp* | | | | | | |
| Tentaculites leclercqius *Clarke* | | | x | | | |
| T. scalaris *Schlotheim* | | | | | | |
| Platyceras *cf.* calantica *Hall* and hebes *Clarke* | x | | | x | | |
| P. *sp* | | | | | | |
| Diaphorostoma desmatum *Clarke* | | x | | | | |
| D. ventricosum (*Hall*) | | x | | | | |
| Poleumita | | | | | | |
| Coelidium *sp. cf.* tenue *Clarke* | | | | x | x | |
| Tropidodiscus *cf.* obex *Clarke* | | | | x | | |
| Plectonotus derbyi *Clarke* | | | | x | | |
| Cyrtolites expansus *Hall* | | x | | | | |
| Phragmostoma diopetes *Clarke* | | + | | | | |
| Aviculopecten alcis *Clarke* | | | | | | |
| A. *cf.* gebhardi (*Hall*) | | x | | | | |
| A. flammiger *Clarke* | | + | | | | |
| Pterinea mainensis *Clarke* | | | | | | |
| P. radialis *Clarke* | | | | x | | |
| P. moneris *Clarke* | | | | | | + |
| Actinopteria textilis (*Hall*) | x | x | x | | | |
| Cyrtodonta beyrichi *Beushausen* | | | | | | x |
| C. muscula *Clarke* | | | | | | + |
| Palaeopinna flabellum *Hall* | | x | x | | | |
| Modiomorpha odiata *Clarke* | | | | | | |
| Prosocoelus pes-anseris *Z. & W. v.* occidentalis *Clarke* | | | | | | x |
| Leptodomus prunus *Clarke* | | | + | | | + |
| Cypricardinia magna *Clarke* | | | | | | + |
| Cypricardella parmula *Clarke* | | | | | | + |
| Palaeosolen simplex *Maurer* | | | | x | | x |
| Cardiomorpha (Goniophora?) simplex *Clarke* | | | | | | + |
| Solenopsis *sp* | | | | | | |
| Ditichia *cf.* elliptica *Maurer* | | | | | | x |
| Rensselaeria ovoides (*Eaton*) | | x | | | | |
| R. *cf.* stewarti *Clarke* | | | | | x | |

**DISTRIBUTION OF THE MOOSE RIVER FAUNA** *(continued)*

x = identity, + = affine

| SPECIES | Helderberg, N. Y. | Oriskany N. Y. | Grande Grève, Gaspé | Chapman | Dalhousie | Coblentzian |
|---|---|---|---|---|---|---|
| R. callida *Clarke* | | | | | | + |
| R. diania *Clarke* | | | | | | + |
| R. *cf.* crassicosta *Koch* | | | | | | x |
| R. (Amphigenia) parva *Clarke* | | | | | | |
| Megalanteris *cf.* ovalis *Hall* | | x | | | | |
| Meristella *sp.* | | | | | | |
| Atrypa reticularis (*Linné*) | x | x | | | | |
| Leptocoelia flabellites (*Conrad*) | | x | x | | | x |
| Spirifer primaevus *Stein. v.* atlanticus *Clarke* | | | | | | x |
| S. arenosus (*Conrad*) | | x | x | | | |
| S. perimele *Clarke* | | | | | | + |
| S. cyclopterus *Hall* | x | | x | | | |
| S. aroostookensis *Clarke* | | | | | | |
| Cyrtina affinis *Billings* | | | x | | | |
| Chonetes impensus *Clarke* | | | | | | |
| C. nectus *Clarke* | | + | + | | | |
| C. (Eodevonaria) hudsonicus *Clarke* | | x | | | | |
| C. canadensis *Billings* | | | x | | | |
| Chonostrophia dawsoni *Billings* | + | + | + | | | |
| Orthothetes (Schuchertella) woolworthanus *Hall* | x | x | + | | | |
| Leptaena rhomboidalis (*Wilckens*) *v.* ventricosa *Hall* | | x | | | | |
| Leptostrophia magnifica *Hall* | | x | x | | | |
| L. oriskania *Clarke* | | x | x | | | |
| Hipparionyx proximus *Vanuxem* | | x | x | | | |
| Rhipidomella musculosa *Hall v.* solaris *Clarke* | | + | + | | | |
| Dalmanella *cf.* circularis *Sowerby* | + | | | | | |
| Pholidops terminalis *Hall* | | x | | | | |
| Total, 65 | 7 (+2) | 18 (+6) | 11 (+5) | 7 | 2 | 7 (+9) |

It is clear from the foregoing that the affinity of this fauna represented in percentage of occurrence is chiefly with the Oriskany of New York, the Oriskany element in the Grande Grève fauna and with the Coblentzian. The species entering into these percentages are, so far as concerns the Oriskany, among the most characteristic of that assemblage.

## III

# THE DEVONIC FAUNAS OF THE CHAPMAN PLANTATION, AROOSTOOK COUNTY, MAINE

The Chapman Plantation is a tract in the northeastern county of Maine, lying directly to the south and west of Presque Isle village on the Bangor and Aroostook Railroad. At several spots in this area are outcrops of sandstone and arenaceous shales, for the most part highly inclined at angles of 40 to 45 degrees to the north or northwest. The presence of these rocks and the fact that they were fossiliferous seems to have been first noted by Professor C. H. Hitchcock in 1861,[1] but the fossils were first systematically assembled by Mr Olof O. Nylander, a resident of Caribou and an intelligent, appreciative and competent collector. In 1898 the writer had made the acquaintance of Mr Nylander by correspondence and had acquired from him for the State Museum considerable series of these fossils. Based upon this material, some description and discussion of these faunas, which were then unknown to the public except for the reference above suggested, had been prepared by me and I was not then aware that the same problem was being elsewhere studied; but my work was for the time terminated by the appearance of a paper in the American Journal of Science [March 1900, p. 203–13] entitled, *The Silurian-Devonian boundary in North America — I. The Chapman sandstone fauna*, by Henry S. Williams. This publication conveyed the intimation that a fuller description of that fauna would follow in some more elaborate treatise and the writer therefore laid aside his manuscript lest he should seem to encroach upon the field of a colleague. Time slipped along; the paper referred to was immediately followed by bulletin 165, United States Geological Survey, entitled, *Contributions to the Geology of Maine*, by Henry S. Williams and Herbert E. Gregory; but this entered into no more precise detail as to the faunas in question, the former publication being in effect an excerpt from the latter.

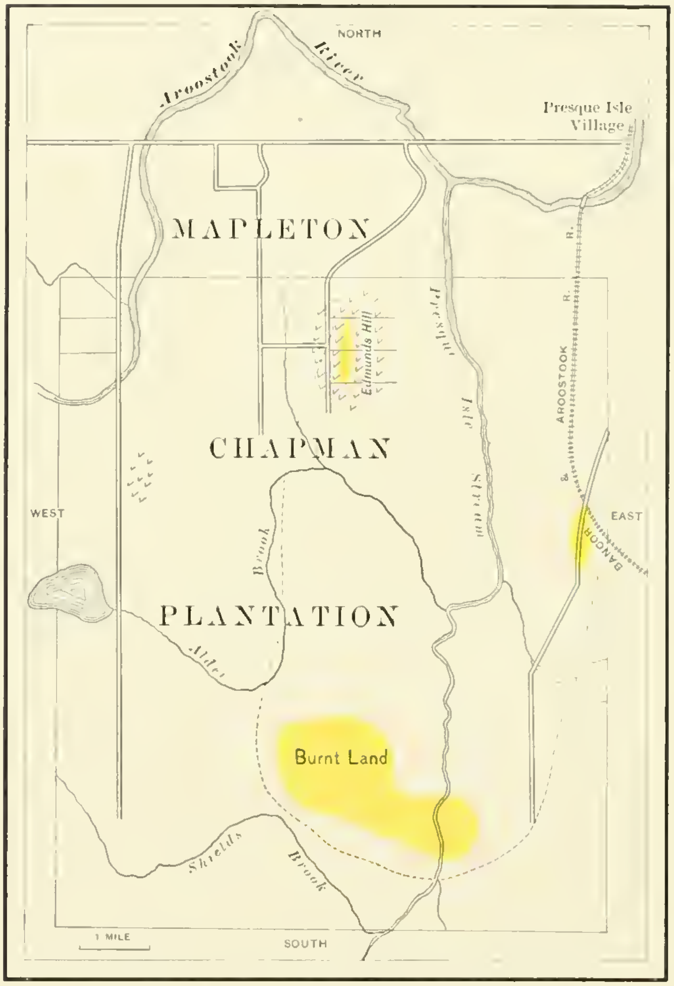
These papers indicated the occurrence in the Chapman Plantation of

[1] *See* his report as State Geologist in 6th Rep't State Bd of Agric. p. 245*.

two areas of fossiliferous rocks: the outcrops along the Presque Isle stream and those at Edmunds Hill. The fossils from these places studied by Professor Williams were not closely identified but only brought into comparisons, often remote, with known New York species of all ages from the Upper Siluric to the Middle Devonic. As the outcrops are not extensive nor widely separated, it has been impossible to credit with value these comparisons between really unlike objects. The main argument of the discussion of the Chapman Plantation fauna assumes to find an agreement in species between that and the fauna of the so called Tilestones of South Wales, which Murchison, after having referred to the Devonic, eventually placed at the top of his Siluric system. Palpably misconceived species of each having been admitted as evidence in this contention and the equivalence in part of the Chapman sandstone fauna with that of the Oriskany of New York being conceded, it is concluded that the line of division between the Siluric and Devonic formations in eastern America is to be drawn at a factitious division line somewhere within the Oriskany formation.

With the species of the fauna before me compared with some care with both American and European contemporary forms I expressed dissent from the conclusions of the writer referred to in a brief address before the American Association for the Advancement of Science in July 1900, notes on which were published in the proceedings of that meeting and in *Science* of the same year.

During the last four years, deeming it desirable to present the fauna in detail and its portrayal an essential part of this treatise, I have availed myself of the further assistance of Mr Nylander to acquire still more complete collections and stratigraphic data from the Chapman Plantation, and the same gentleman has also placed at my disposal the entire suite of these fossils from his private collection. To further test the suggestion of the affinity of this fauna with that of the Tilestones of Murchison, I have been so fortunate as to acquire collections both from localities in Wales and those in the Ludlow section representing the upper part of the Downtonian series, made in the field at my request by such accomplished observers as




SKETCH MAP SHOWING THE DISTRIBUTION
OF THE CHAPMAN SANDSTONE ON
THE CHAPMAN PLANTATION

Drs A. Smith Woodward and C. Davies Sherborn. These collections from Horeb Chapel and Felindre in Wales; Bradford, Whitecliffe, Ludford, Brindgwood Chase, Ombury, Downton, Hargeest Mill and other localities, supplement an excellent series of specimens presented years ago to the State Museum by Sir Roderick Murchison when director general of the geological survey of Great Britain. Cautious examination and comparison of this material with that from Aroostook county show a possibility of only remote and indirect comparison, too frail to justify extended discussion, sufficient to indicate that the Tilestones of Wales and Ludlow are unlike quantities faunally, and that in no particular worthy of serious consideration is there any substantial organic resemblance between either and those under present consideration.

It will be found on reference to my very brief published comments on this fauna that a strong affiliation was indicated to the Coblentzian of the Rhineland. In my restudy of the fauna, of which the present presentation is the result, I have to acknowledge the generous aid which has been afforded by Prof. E. Kayser of Marburg and Dr F. Drevermann of Frankfort, who have supplied me with series of specimens and have made comparisons of and commentaries upon my own determinations. With such assistance, some personal field acquaintance with the European faunas and with the help of considerable series of Coblentzian material already in the State Museum, it has been possible to secure in dependable measure the accuracy of determinations and comparisons with Coblentzian species. It is in this resemblance with the rhenish lower Devonic that the faunas of the Chapman Plantation find their most pronounced character in contrast with those of a more strictly American type. This fact is forcibly brought out by study of the tabulation given on a following page.

### Stratigraphy of the Chapman Plantation

The outcrops which have afforded the fossils here discussed occur in two areas: (1) in the upper reaches of Presque Isle stream over an area bounded by that stream, Shields brook and Alder brook lying in the southern part of the Plantation; (2) Edmunds Hill, a small outlier near

the north line of the Plantation and about 3 miles north of no. 1. These areas are shown on the accompanying map. While the rocks displayed at these two places are included under the general term of Chapman sandstone (Williams), there are highly noteworthy differences in the fauna at the two areas of the outcrop which are expressed in the tabulation following.

*Presque Isle stream section*

The general relations of the strata at the Presque Isle stream and westward over the tract known as the Burnt land are shown in the accompanying section, which may be described as follows in ascending order.

| | feet |
|---|---|
| A Dark, fine grained sandstone; no fossils | $\pm$100 |
| B Sandstones and shales, some of them much sheared. Fossils | $\pm$100 |
| C Thick-bedded sandstone exposed on both sides of the stream; no fossils | $\pm$200 |
| D Thick-bedded sandstone as in C but containing fossils | 25 |
| E Sandstone like that of D and C containing no fossils and marking the top of the section on both sides of the stream. | |

The dip in the section is 38 to 40° n. and the strike nearly east-west.

*Edmunds Hill section*

In this outcrop the rocks are heavy but broken sandstones with a dip of 80° e. and a nearly north-south strike. The entire mass is overlain by andesite and the fossils have been largely collected from the debris.

There is a third exposure of the sandstone east of the Presque Isle stream as indicated on the map but this has afforded no fossils.

It is probable that the entire area between these several exposures is occupied by the Chapman sandstone which with their accompanying andesite intrusives thus occupy nearly all the area of the Chapman Plantation.

## DESCRIPTION OF THE FAUNA OF THE CHAPMAN SANDSTONE

### Asterolepis clarkii Eastman

*See* N. Y. State Mus. Mem. 10 1907. p. 40, pl. 7, fig. 7, 8

*Locality.* Presque Isle stream.

### Spirorbis sp.

Abundant on dead shells.
*Locality.* Presque Isle stream.

### Homalonotus vanuxemi Hall

Plate 22, figures 2-6

*See* p. 67

Homalonotus vanuxemi Hall. Palaeontology of New York. 1859. 3: 352, pl. 73, fig. 9-13
Homalonotus vanuxemi Hall & Clarke. *op. cit.* 1887. 7: 11, pl. VB

This species, rare in the Helderbergian (New Scotland beds) from which it was described, but more frequent in the calcareous Oriskany fauna of southeastern New York, is well marked by its highly convex, well segmented pygidium. There is nothing in the structure of the parts before us that suggests any similarity to species of the genus from the transatlantic strata. The parts are wholly without ornament, in which respect the specimens are in harmony with other American species and in measurable contrast to the more prevalent spinous forms of the Coblentzian of Europe and the Bokkeveld beds of South Africa. The pygidium is narrow, relatively slender, with abruptly sloping sides and sharply segmented in the same degree as the pygidium of H. vanuxemi in the Dalmanites dentatus beds of Port Jervis, New York (Oriskany). The head also possesses the rather broad anterior border which characterizes H. vanuxemi. We have had occasion previously to observe that sharp segmentation of either pygidium or head is an index in this genus of early age; that in later Devonic forms this segmentation is obscured at maturity though it may be apparent in young stages.

*Locality.* Edmunds Hill.

### Phacops cf. logani Hall

*See* pt 1, p. 118; pt 2, p. 18

This species is represented by a glabella and several pygidia. The former shows it to be a normal member of the genus with full coalescence of the glabellar lobes and highly pustulose surface. The pygidia have the pleurae divided as in other early species of the genus. Such typical and normal Phacopes are extremely rare in Siluric faunas. We have previously

called attention to the Lower Siluric species, P. primaevus from Percé [N. Y. State Mus. Mem. 10, pt 1, p. 73] and Weller has recently described a Niagaran form of fully mature type, P. handwerki [Chicago Acad. Sci. Bul. 4, pt 2. 1907. p.271, pl. 24, fig. 6, 7].

*Locality.* Edmunds Hill.

### Phacops (Phacopidella) nylanderi Clarke

Plate 22, figure 1

Phacops (Phacopidella) nylanderi Clarke. N. Y. State Mus. Bul. 107. 1907. p. 166

This is an addition to the peculiar group of early Devonic species of which we recognize the following other members: P. brasiliensis (Maecurú), P. anceps (Decewville), P. correlator, New York Oriskany and Gaspé sandstone. We have noted in what respects this group departs from the structure presented by P. downingiae, the exemplar of the generic group Acaste = Phacopidella Reed. The material from this locality has afforded but a single cephalon of small size with semicircular outline, rotund but not protuberant glabella, in which all glabellar lobes are extinct save that at the base which takes the form of a narrow and obscure ring. The preservation here is without compression which in some of the other species of the series serves to indicate the glabellar furrows. The nuchal ring is elevated, the eyes relatively large, and the small cheeks are apparently produced into short genal spines. The length of this specimen is 4 mm and its full width 8 mm.

No indications of other parts that can be referred to this species are present.

*Locality.* Edmunds Hill.

### Dalmanites cf. micrurus (Green)

Plate 22, figures 7, 8

*See* pt 1, p. 120; pt 2, p. 18

There are two incomplete pygidia of rather small size in the material and these have the segmentation and aspect of D. micrurus as it occurs in the Helderbergian of New York. We know no other parts which can be referred to the same species.

*Locality.* Edmunds Hill.

### Beyrichia kloedeni McCoy var. ?

*See* p. 19

This entomostracan has nothing in common with the widely variant expressions assigned to the cosmopolitan Siluric species B. tuberculata

by Klöden [Verst. d. Mark Brandenburg] and Reuter [Zeitschr. d. deutsch. geol. Gesellsch. 1885. v. 37]. Among those, the simple form of these specimens is not to be found. The object from the Tilestones figured under this name in *Siluria* and the *Silurian System* may have some relation to that species but the Chapman Plantation forms are quite distinct. These on the Presque Isle agree very well with Jones's B. kloedeni var. acadica from the Lower Devonic at Stewart's cove, Dalhousie, N. B. Beyrichia kloedeni as interpreted by Jones and other writers is a species of very wide range occurring even as high up as the Carbonic. Some of the specimens from the Presque Isle with hypertrophied lateral lobe can not be separated from the B. kloedeni var. from the Onondaga limestone of Ontario county, N. Y., figured by Jones in the Quarterly Journal of the Geological Society, volume 46, plate 21, figure 1a, 1890.

*Locality*. Presque Isle stream.

### Beyrichia oculina Hall

Beyrichia oculina Hall. Palaeontology of New York. 1859. 3:378

The simple subcentral well defined tubercle of this species and its undivided lateral and ventral lobes, as well as its subequilateral outline are index characters presented by some of our specimens. There is no occasion to confound the species with that from Presque Isle stream. Beyrichia oculina was described from the Coeymans limestone (Helderberg) of New York.

*Locality*. Edmunds Hill.

### Orthoceras norumbegae Clarke

Plate 22, figures 14, 15

Orthoceras norumbegae Clarke. N. Y. State Mus. Bul. 107. 1907. p.177

A robust shell of which we have about six inches of the final part, retaining the surface sculpture. The shell seems to have tapered gradually and to possess a circular section. The fragment at hand has a length of 165 mm, a width at the top of 75 mm, at the bottom of 60 mm. The sculpture consists of incised vertical lines at irregular intervals, making very flat and low elevated striae, some broad, some very narrow and threadlike, all rather wavy and irregular in their course, large and small interspaced without order. At wider intervals are deeper longitudinal sulci. All are crossed by faint and irregularly distributed concentric lines. This style of exterior is highly unusual and quite peculiar.

*Locality*. Edmunds Hill.

### Tentaculites scalaris Schlotheim

Plate 22, figures 9-11

Tentaculites scalaris Schlotheim. Petrefaktenkunde, p.377, pl. 20, fig. 8, 9; *et auctorum*

Tentaculites scalaris Schlotheim. N. Y. State Mus. Bul. 107. 1907. p.174

There are no evidences of distinction between specimens of Tentaculites found in the Chapman Plantation and this well known Coblentzian species. Our specimens bear the strong rounded annulations, subject to very slight variation with some irregularity in the intervals and these annulations are covered with fine concentric lines.

*Locality*. Edmunds Hill.

### Conularia cf. huntiana Hall

Plate 22, figures 12, 13

*See* Conularia huntiana Hall. Palaeontology of New York. 1859. 3:348, pl. 72A, fig. 3

So far as exterior markings can be relied on for the identification of species this Helderbergian form appears to be present in the Chapman Plantation. The specimens present two of the four sides of a narrow and slender shell in which the surface is transversely lined by elevated ridges at usually irregular intervals, in some places crowded, in others less frequent, the depression being puckered into vertical elevations and depressions which may rise to the summits of and crenulate the intervening ridges. In the detail of structure it is in contrast to such early Devonic Conularias as C. lata Hall, in which the sculpture is a series of beads on the ridges only.

*Locality*. Presque Isle stream.

### Plectonotus cf. derbyi Clarke

Plate 24, figures 1-11

*See* Plectonotus derbyi Clarke. The Paleozoic Faunas of Pará. Eng. ed. p.38, pl. 3, fig. 14–18

With the types of this species from the Maecurú river before me I can observe no very material difference between them and the sulcate shells here figured from the Chapman Plantation. These bear the two deep lateral sulci, between them lying the broad, flat dorsum and at the aperture a reentrant median angle expressing together with faint median revolving furrows the same evidence of a slit band as that found in the specimens of P. derbyi. The latter at times exceeds the dimensions of the Maine shells but these nevertheless attain notable size. There is a considerable series of these sulcate bellerophons which, as we have heretofore pointed out, have commonly passed under the term Bellerophon trisulcatus Sow-

erby. That, however, is a little and deeply sulcate species from the Tilestones. The three varieties of this species described by the Sandbergers from the Devonic are independent species departing widely from B. trisulcatus and doubtless representing distinct genera. One of them, var. tumidus, common in the Spiriferensandstein, is broad and has shallow sulci far at the side, a convex back and apparently no slit band; var. acutus is a Tropidodiscus; B. coutinhoanus Hartt & Rathbun, from the Ereré Middle Devonic (Brazil) is a Bucaniella with highly convex dorsum and shallow lateral sulci, while Plectonotus ? salteri is a species from Maecurú, likewise with shallow furrows. We have only Plectonotus derbyi left as a species characterized by its deep sulci, which are not far to the side, and flat backed dorsum.

*Locality*. The Burnt lands 2 miles west of Presque Isle stream, in sandstone. Not observed in the shales.

Somewhat similar shells occur at Edmunds Hill but they are not in our judgment of the same species, differing therefrom as Bucaniella coutinhoana differs from the foregoing. The sulci are more shallow and lateral; the dorsum is broad and convex. We hesitate therefore to associate them under the same name.

### Tropidodiscus obex Clarke

Plate 22, figures 27-30

Tropidodiscus obex Clarke. N. Y. State Mus. Bul. 107. 1907. p. 193

This is a species of unusual interest in that it represents the only known member of Meek's genus Tropidodiscus, save the type T. curvilineatus (Conrad) from the Onondaga limestone of New York. The Maine shell is smaller than that, very sharply keeled, narrowly umbilicated, with the outward slope of the whorls direct and without evidence of revolving sulci, the inner slope being vertical. The surface is crossed by fine concentric growth lines bending sharply back to the keel. In Tropidocyclus (de Koninck, emend. Clarke) the closely appressed shell still carries pronounced revolving furrows, and the slit band, though present, may be obscured by overgrowth or thickening of the shell.

*Locality*. Edmunds Hill.

### Coelidium tenue Clarke

Plate 23, figures 8-10

*See* p. 23

Coelidium tenue Clarke. N. Y. State Mus. Bul. 107. 1907. p. 190

This is an elongate, turriculate and slender shell with sharply keeled whorls margined by a simple slit band to which the surface slopes in an almost direct plane without either convex or concave curvature, the surface

of the whorls bearing reflected concentric lines. The species comes very close to Kayser's Murchisonia losseni [Fauna des Hauptquartzites, p.15, pl. 8, fig. 9] from the Spiriferensandstein of the Hartz and the Coblentzian of the Rhine. While approaching this form most closely it is also allied to the M. angulata Phillips var. a. MVK [Fossils Older Deposits Rhenish Provinces, pl. 32, fig. 7] from the Stringocephalus limestone of the Rhine. Attention may also be directed to the shell identified by Verneuil from the Lower Devonic of Nishnij-Tagilsk in the Urals [Geol. de la Russie, 1845, v. 2, p.339, pl. 22, fig. 7] under the name of M. cingulata Hisinger. Kayser remarks that this is not Hisinger's species, which is confined to the Swedish Upper Siluric. The forms described by Billings from the Gaspé limestone as M. hebe and M. egregia are of the same type but are stouter shells with more convex volutions. The Holopella obsoleta of Sowerby figured by Murchison among the fossils of the Tilestones may be of similar type but it is known in literature only from internal casts which serve but a faulty purpose in the determination of such shells.

*Locality*. Presque Isle stream. Abundant also at Dalhousie, N. B.

### Eotomaria hitchcocki Clarke

Plate 23, figures 11-19

*See* p. 139

Eotomaria hitchcocki Clarke. N. Y. State Mus. Bul. 107. 1907. p.190

Shell with rather low, somewhat concave spiral of four to five whorls, the spire usually much depressed when in the shales. The surface of the whorls is regularly sloping, very slightly concave, giving an almost uninterrupted slope to the spire. Periphery of body whorl sharply carinate or even extended into a keel or flange which seems to carry a slit band. Aperture sharply angulated exteriorly, subcircular in outline, thickened and slightly excavate on the inner lip. Base of shell broad and nearly flat for its full width. Fine concentric growth lines are the only sculpture. It is possible that this shell may be of similar character to the Trochus ? helicites Sowerby from the Tilestones of Horeb Chapel [*see Siluria*, pl. 34, fig. 12] but comparison can be based only on the resemblance of the internal casts of the two shells for of the exterior of the latter we have as yet no definite knowledge. It is instructive to observe that the Spiriferensandstein of the Oberharz (Bocksberg) carries an Eotomaria of similar style with extended peripheral flange [Pleurotomaria kleini Beushausen, *Beitr. zur Kenntn. d. Oberharz. Spiriferensandst.* 1884. pl. 1, fig. 10], though a shell of much larger type than that here described.

*Locality*. Presque Isle stream and in the Burnt lands 2 miles west.

*Specific name*. Prof. C. H. Hitchcock, State Geologist of Maine, New Hampshire and Vermont.

### Holopea beushauseni Clarke

Plate 23, figures 20–22

Macrocheilus? sp. Beushausen. Abhandl. z. geol. Specialk. v. Preussen etc. 1884. pl. 1, fig. 7

Holopea beushauseni Clarke. N. Y. State Mus. Bul. 107. 1907. p. 188

Shell of considerable size, stoutly subconical with sutures slightly impressed; whorls four to five, depressed convex, overlapped for one fourth to one third of their width; surface smooth or with fine concentric lines; angle of spire 40 degrees; final whorl at its commencement having a diameter equal to the hight of the spire above; at the aperture much elongated, explanate or reflected in the lower part. The whorls sometimes show a slightly shouldered appearance and the final whorl may be subangular about its base. This shell occurs in great abundance in the form of distorted casts of the interior and is of the type of structure exhibited by such shells as Conchula steiningeri Koken [Neues Jahrb. für Mineral. Beilageband 6. 1889. pl. 13, fig. 2] and Bucinum arculatum (Schlotheim) MVK [Fossils Older Dep. Rhen. Prov. 1842. pl. 32, fig. 1]. With the former it may be directly compared. Both of these shells are from the Middle Devonic. Beushausen figures as Macrocheilus ? sp. an internal cast of like aspect and proportions from the Spiriferensandstein of the Oberharz (Bocksberg), identical indeed so far as identity can be indicated by internal casts. Specially noteworthy is the agreement in relative size of the final whorl and the explanate form of the apertural margin.

*Locality*. Presque Isle stream. A shell of somewhat similar character but apparently stouter with more convex whorls occurs at Edmunds Hill.

### Platyceras leboutillieri Clarke

Plate 23, figure 1

*See* pt 1, p. 145

Platyceras leboutillieri Clarke. N. Y. State Mus. Bul. 107. 1907. p. 181

Platyceras leboutillieri Clarke. N. Y. State Mus. Mem. 9, pt 1, p. 145, pl. 14, fig. 1–4

I identify with this species from the Grande Grève limestone at Percé, the small specimen here figured.

*Locality*. Edmunds Hill.

### Platyceras hebes Clarke

Plate 22, figures 17–19

*See* p. 68

Platyceras hebes Clarke. N. Y. State Mus. Bul. 107. 1907. p. 185

Shell conical, slightly oblique, apex blunt or minute, surface expanding rapidly with a vertical slope on the posterior and a more broadly curved

slope on the anterior side; lower part of the cone obscurely plicated, aperture nearly round.

This singular expression of Platyceras, noteworthy for its broad, blunt apex, is quite unusual in American faunas, but such a shell has been noticed by OEhlert in the Lower Devonic of Angers and figured in the *Bulletin de la Société Géologique de France*, 1890, volume 17, plate 19, figure 4.

*Locality*. Edmunds Hill.

### Platyceras kahlebergensis Beushausen

Plate 23, figures 2 7

Capulus kahlebergensis Beushausen. Abhandl. zur geolog. Specialk. Preussen. 1884. pl. 1, fig. 14

Platyceras kahlebergensis Beushausen. N. Y. State Mus. Bul. 107. 1907. p.185

There seems no doubt of identity in this case. The species is a Platyceras with a Diaphorostomalike spire from which the body whorl expands rapidly and carries a deep revolving sulcus on the lower side.

*Locality*. Edmunds Hill, and in the Spiriferensandstein of the Hartz qountains at the Kahleberg.

### Loxonema sp. cf. funatum A. Roemer

Plate 23, figures 25, 26

Loxonema sp. cf. funatum A. Roemer. N. Y. State Mus. Bul. 107. 1907. p.186

A shell of relatively rare occurrence with very faint sinuous ridges on the internal cast. It suggests the species referred to from the Spiriferensandstein of the Hartz mountains.

*Locality*. Edmunds Hill.

### Pterinea cf. fasciculata Goldfuss

Plate 25, figures 1-7

Pterinea fasciculata Goldfuss. Petrefacta Germaniae. 2. p.137, pl. 129, fig. 5

Pterinea fasciculata Frech. Devon. Aviculiden Deutschlands. 1891. p.84, pl. 8, fig. 1; pl. 9, fig. 1–3

Not P. cf. fasciculata (Goldfuss). Clarke. N. Y. State Mus. Bul. 107. 1907. p.204, figures

The pterineoids of this fauna are chiefly true Pterineas and none show the degenerative condition of the hinge structure which accompanies and characterizes the generally later genera Actinopteria and Liopteria. This species is radially and coarsely ribbed, quite convex and oblique along the crescence line, the anterior wing strongly developed on the abrupt anterior slope and the hinge teeth both beneath the beak and behind it very pronounced. In all respects it is very like the species cited so far as the former

is known. It is possible, however, that the coarsely ribbed internal casts may belong to the more finely marked form to which we refer in the following.

*Locality.* Presque Isle creek.

### Pterinea radialis Clarke

Plate 24, figures 21-24

*See also* p. 72

Pterinea radialis Clarke. N. Y. State Mus. Bul. 107. 1907. p.207

This is one of a group with an Actinopterialike exterior, but it has the highly developed anterior muscle scar, the umbonal and the lateral teeth of Pterinea. No attempts therefore at correlation with species which have been determined as Actinopteria and Avicula are here called for. The shells have the size and proportions of the foregoing (P. cf. fasciculata) and the following species. The hinge line is but slightly extended posteriorly, the anterior wing well marked, convex and sulcated; the crescence line oblique and the valve highly convex in the umbonal region, with abrupt anterior and more gradual posterior slope. The surface sculpture consists of closely crowded subequal rounded riblets, alternation of size being noticeable near the margins.

*Localities.* Presque Isle stream, Matagamon lake and elsewhere, Me.

### Pterinea chapmani Clarke

Plate 25, figure 11

Pterinea chapmani Clarke. N. Y. State Mus. Bul. 107. 1907. p.203

A large left valve has the beak almost terminal, a long straight hinge, lateral teeth not visible but umbonal teeth sharply defined; posterior wing narrow and not extended, anterior wing very small; anterior slope abrupt, almost vertical; umbo narrow, elevated, the general surface of the valve broadly convex; outline oblique. The surface carries faint radial riblets, which are obsolete on the anterior slope.

The species differs from any of its associates in its obliquity, abrupt anterior slope, abbreviated anterior wing and short posterior extension.

*Locality.* Edmunds Hill.

### Pterinea edmundi Clarke

Plate 24, figures 12-18

Pterinea edmundi Clarke. N. Y. State Mus. Bul. 107. 1907. p.203

The distinguishing marks of this species are found in its ornament and variable outline. In aspect it approaches very closely the P. radialis from Presque Isle stream but its left valve is sometimes more oblique,

sometimes more erect, its umbonal convexity less marked. Its sculpture consists of coarse flattened ribs which are more or less irregularly interspersed with ribs of smaller size; on the anterior slope these gradually disappear leaving the anterior ear smooth, but on the posterior slope they are continued to the hinge. The posterior wing is cancellated and the cardinal line more strongly striate. The left valve which is less convex than the other has the radial riblets developed only on the median area, both anterior and posterior wings being smooth save on the posterior hinge where there is a cancellated group of three or four strong radii. The variations in the outline of this species reach an extreme in the variety subrecta [pl. 24, fig. 19, 20], which retains the same style of ornament as the foregoing and relative proportions and development of the parts, but is quite erect. This appears to be a persistent feature which we find exemplified in several examples.

*Locality*. Edmunds Hill.

### Pterinea brisa Clarke

Plate 25, figure 10

Pterinea brisa Clarke. N. Y. State Mus. Bul. 107. 1907. p.208

An elongate shell, quite erect, the axis of growth being essentially at right angles to the hinge. The body is produced and moderately expanded; the wings distinctly developed but not large, the posterior being narrow, the anterior short and the byssal sinus well defined. The length of the hinge in the specimen before us is 32 mm, the vertical hight 40 mm. The beak is at the anterior third of the hinge. The surface is marked by radial elevated lines with broad, flat interspaces, broken by intercalated lines of minor series. In the umbonal region the lines are close together but they spread outward and the primary interspaces become broad. The body of the valve shows few concentric lines but these are strong on the wings and those on the posterior wing are cancellated by the radii near the hinge.

*Locality*. Edmunds Hill.

### Pterinea sp.

Type of Pt. laevis Goldfs.

Plate 24, figures 29, 30, 33

Some incomplete specimens indicate a shell of the general size and proportions of the forms above described but having a thick shell with smooth or roughly lamellose exterior.

*Localities*. Presque Isle stream and Edmunds Hill.

### Pteronitella peninsulae Clarke

Plate 25, figures 8, 9

Pteronitella peninsulae Clarke. N. Y. State Mus. Bul. 107. 1907. p.212

Very sharp internal casts of right valves show the characteristic structure of this genus as defined by Billings, clearly demonstrating the departure from the type of Pteronites in the presence of a series of Cyrtodontalike teeth beneath the beak, together with the long posterior ridgelike tooth. These valves are very oblique, the straight hinge making the greatest diameter of the shell ; the anterior wing is insignificant and the posterior not extended. From anterior and posterior cardinal angles the lateral margins depart at almost 90 degrees. The beak is very near the anterior extremity and the shell is quite convex along the oblique and somewhat curved crescence line, from which the anterior slope is abrupt and the posterior abrupt and slightly concave, at first becoming flat at the hinge. The anterior scar is small and deep, the posterior large and faint. Beneath the beak are three or four teeth diverging from the edge of the ligament area.

*Locality.* Presque Isle stream.

### Pterinopecten aroostooki Clarke

Plate 24, figures 25–28

Pterinopecten aroostooki Clarke. N. Y. State Mus. Bul. 107. 1907. p.199

Shells subcircular or somewhat transverse with outline slightly extended posteriorly ; beak at the anterior third of the hinge, posterior hinge straight, reaching to the extreme limit of the outline, posterior wing very slightly extended ; anterior hinge straight, anterior wing moderately large but undulated, an oblique ridge traversing it from the beak just beneath the hinge leaving the portion behind it depressed and flat. Below this ridge the ear is depressed or broadly sulcate. Umbo convex, narrow ; pallial region sloping evenly downward and depressed. The surface sculpture consists of well defined ribs, which are broad and sparse over the median region where they usually carry one very small rib between each two of the large ones. On the anterior slope and wing these ribs are smaller and also on the posterior slope and wing. Cancellating lamellae cross the posterior wing and are visible in the sulci of all the posterior surface of the valve. The left valves only are known.

*Locality.* Edmunds Hill.

## Myalina pterinaeoides Clarke

Plate 25, figures 12–18; plate 26, figures 1–3

Myalina pterinaeoides Clarke. N. Y. State Mus. Bul. 107. 1907. p.213

One of the commoner species at Presque Isle stream is a Myalina with a striking resemblance throughout, save in the character of the hinge, to certain Pterineas with curtailed posterior wing, and specially similar to Pt. follmanni Frech.[1]

The frequent internal casts show the species to be devoid of the hinge teeth of Pterinea and present only the moderately broad ligamental striations of Myalina and the abbreviated earless and abrupt front margin. This latter feature is rather feebly developed but when the shell is retained the anterior incurvature with margins truncated and meeting at right angles is evident. In other respects we may note the following characters: The shell is relatively suberect without posterior hinge, obliquely elongate, suboval with greatest width across the pallial region, the hinge line being short, not more than one half as long as the length of the shell. The valves are shallow and thick; posterior muscle scar well defined, situated at one half the length of the shell; pallial line short, barely reaching beyond the middle; anterior scar absent.

The surface of the shell is coarsely rugose in concentric growth lines and is without other ornament. Of such a species as this we know nothing among the faunas of the Appalachian early Devonic.

*Locality*. Presque Isle stream.

## Modiomorpha vulcanalis Clarke

Plate 26, figures 9–11

Modiomorpha vulcanalis Clarke. N. Y. State Mus. Bul. 107. 1907. p.219

Shell robust, with very thick valves; outline short, obliquely cordate, hinge line oblique, beak in front of the middle, not elevated; umbonal ridge low but distinct, from which the slope anteriorly is broad and very gently convex while posteriorly it is at first gently concave, then depressed and almost flat near the hinge line. The marginal outline is narrow in front at the extremity of the oblique hinge, widens in a low curve backward, turns almost at right angles at the end of the crescence line, curving thence broadly upward and forward, joining the obliquely elevated hinge in a broad curve. The length and width of the shell are nearly the same.

The resemblance of this species to Drevermann's Goniophora

[1] Frech. *op. cit.* pl. 10, fig. 5; Drevermann. Fauna d. Untercoblenzsch, p.82, pl. 10, fig. 1, 2.

cognata[1] is very close in all visible features save that the crescence ridge in the latter is somewhat sharper. It may also be compared to M. elevata Krantz of the lower Coblentzian.[2] Professor Kayser suggests a similarity with M. siegenensis Beushausen.[3] At all events the short obliquely cordate shell is not familiar in Appalachian faunas of this age.

*Locality.* Edmunds Hill.

### Modiomorpha protea Clarke

Plate 26, figures 4-8; plate 27, figure 7

Modiomorpha protea Clarke. N. Y. State Mus. Bul. 107. 1907. p.220

Shell elongate, subrhomboidal, beaks anterior, posterior hinge not elevated, crescence line high, relatively approximate to hinge. Length and hight as four to three. Anterior margin broadly rounded, not narrow, basal margin sloping gently downward to near the umbonal ridge, thence bending up and back in a broad angle; posterior hinge angle rounded. Umbonal ridge subangular, sharply defined by the rapid slope of the surface toward the hinge, but not elevated above the general convexity of the sides of the valves.

Anterior adductor scar with the little foot muscle scar well defined.

This species is somewhat variable in outline, some of the specimens assigned thereto being considerably larger than others. This variation, however, is not expressed in the typical specimens at Edmunds Hill as well as in the examples referred to the same species occurring at Presque Isle stream.

*Localities.* Edmunds Hill and Presque Isle stream.

### Modiomorpha sp.

Plate 27, figure 10

A single internal cast represents a form of this genus with narrowed anterior extremity and comparable to M. cymbula Hall of the Ithaca group of New York[4] and such shells as M. modiola Beushausen of the Coblentzian.[5]

*Locality.* Edmunds Hill.

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[1] Fauna d. Untercoblenzsch. 1902. p.88, pl. 10, fig. 15, 16.
[2] Beushausen. Lamell. d. rhein. Devons. p.23, pl. 2, fig. 9–11.
[3] *op. cit.* p.24, pl. 2, fig. 8.
[4] Pal. N. Y. v. 5, pt 1, p.282, pl. 36, fig. 19, 20.
[5] Lamellibr. rhein. Dev. p.22, pl. 2, fig. 1–5.

### Grammysia modiomorphae Clarke

Plate 27, figures 1 6, 8

Grammysia modiomorphae Clarke. N. Y. State Mus. Bul 107. 1907. p.221

Shell large, elongate, generally with strong oblique medial depression dividing the valves into two lobes, sometimes a low ridge lying in the bottom of this depression; beaks at the anterior one third of the hinge, slightly elevated, appressed and incurved; hinge line direct, not elevated; marginal outline incurved in front of the beaks, rather narrow at the anterior extremity, broadly incurving on the basal margin at the median sulcus, recurving in a broad angle at the postlateral extremity. The median sulcus varies in width and strength in different examples, at times being highly and somewhat unequally developed on both valves, rather more on the right and again being only a low, broad depression.

Muscle scars obscure, only the anterior abductor being occasionally shown on our specimens. Surface markings concentric striae strongly marked at the anterior margin.

The elongate form of this shell and its subsequent extremities give it the appearance of a Modiomorpha. The evidence seems to indicate however that it is a Grammysia of unusual expression, with which it is not easy to find comparison among other shells. Drs Kayser and Drevermann who have kindly examined specimens of the shell agree that it is very similar to Beushausen's G. prümiensis[1] from the upper Coblentzian of the Eifel.

*Locality.* This species is the most abundant of the lamellibranchs at Edmunds Hill.

### Grammysia sp.

With G. modiomorphae occurs a somewhat allied shell with umbonal ridge high, convex and close upon the hinge, a low submedian depression and very narrow anterior extremity. It appears to be an undescribed species and I should regard its generic position as undetermined.

*Locality.* Edmunds Hill.

### Leptodomus communis Clarke

Plate 28, figures 8-10

Leptodomus communis Clarke. N. Y. State Mus. Bul. 107. 1907. p.224

Shell elongate with a Cimitarialike curve to the hinge, beak anterior, hinge not equaling the length of the shell; lower margin sinuate, curving upward posteriorly to a narrowed, subacute extremity whence the posterior edge retreats to the hinge. Surface deeply sulcate from umbo to basal

[1] *op. cit.* p.243, pl. 24, fig. 2-4.

margin. Umbonal ridge conspicuous, blunt and broadly curved, exterior with low irregular concentric folds.

*Locality*. Presque Isle stream.

### Leptodomus corrugatus Clarke

Plate 28, figure 6

Leptodomus corrugatus Clarke. N. Y. State Mus. Bul. 107. 1907. p.224

Shell small, beak at the anterior third of the hinge, outline subelliptical, posterior slope gently sulcate, smooth, anterior surface coarsely corrugated and over the median area these anterior ridges duplicate, there being on the whole on the lateral slope two ridges for every one on the anterior surface. Median surface slightly depressed.

*Locality*. Presque Isle stream.

### Palaeoneilo

There are several species of this genus all of them found in the Presque Isle stream fauna, and most of them are characterized by an oblique posterior cincture, making a sinuous postlateral margin. This particular style of expression typified a group of shells which seems almost everywhere, except in New York, to emphatically characterize the arenaceous Lower Devonic. Such species occur in the Coblentzian sandstone in very notable abundance; reference may be had to a long list of these described and figured by Beushausen, Maurer and others. A similarly striking development of these sinuous Palaeoneilos is notable in the Lower Devonic Maecurú sandstones of Pará and specially in the Bokkeveld beds of Cape Colony, South Africa.

### Palaeoneilo orbignyi Clarke

Plate 28, figures 20-23

Palaeoneilo orbignyi Clarke. Palaeozoic Faunas of Pará. Eng. ed. from Archiv. do Mus. Nacionial do Rio de Janeiro. 1900. 10:74. pl. 8, fig. 14-17

This species described from the lower arenaceous Devonic of the Maecurú river, Brazil, is reproduced in the form here figured, which is distinguished from its associates and from other species of this time by its highly convex valves with arched umbones, incurved beaks and strongly sulcate and sinuate posterior surface. The hinge has not been observed in the original material and from the specimens in hand we observe that it bears a posterior row of ligament pits which begin minutely beneath the beak where this posterior limb is separated from the anterior by a faint oblique line; these pits at first vertical, rapidly become oblique and coarse backward, slightly chevroned but losing their geniculation toward the end of the row at the inner edge of the posterior adductor. The pits of the

anterior row begin abruptly beneath the beak and are coarse and oblique, 4 to 5 in number.

*Localities.* Abundant at Presque Isle stream and in the Burnt land westward.

### Palaeoneilo mainensis Clarke

Plate 28, figures 24-30

Palaeoneilo mainensis Clarke. N. Y. State Mus. Bul. 107. 1907. p.230

Shell attaining large dimensions for a species of the genus, subtrihedral, depressed convex, with beak but little in front of middle of the hinge. Hight three fifths of the length. Posterior surface gently sinuate and the postlateral shell margins correspondingly emarginate, extremities narrow. Surface covered with fine concentric growth lines. On the interior the muscle scars are deeply impressed, there being a ridge on the umbonal side of each but both anterior scar and ridge are very much the more strongly marked and almost attain the strength of the ridge in Nuculites. The hinge has the following structure: The posterior arm carries a row of 16 to 18 ligament pits ending at the anterior edge of the posterior adductor. Those directly under the beak are very slender and transverse, outward they become stronger and more and more chevron-shaped; the anterior arm is not separated by an oblique line from the posterior and carries seven or eight pits, increasing outward rapidly in size and becoming strong and oblique at the terminus near the inner edge of the adductor. In respect to hinge structure, the species is readily distinguishable from P. orbignyi, which it sometimes resembles in form. It is not easy to find European or Mississippian species which this shell resembles in form and hinge structure. Comparisons of similarity are readily made with species of the Devonic on both sides of the Atlantic but these are not helpful in the absence of agreement in critical details. We may observe, however, that the shell occasionally puts on a concentrically wrinkled surface which we find together with agreements in outline, convexity and, so far as can be ascertained, in hinge structure, expressed in P. maureri Beushausen and some of its variants in the Coblentzian fauna. [Beush. *op cit.* p.85, pl. 7, fig. 11–28]

*Localities.* Abundant at Presque Isle stream and 2 miles westward in the Burnt district.

### Palaeoneilo circulus Clarke

Plate 28, figures 12-14

Palaeoneilo circulus Clarke. N. Y. State Mus. Bul. 107. 1907. p.231

Shell small, almost circular in outline, slightly oblique, depressed and evenly convex, with beak somewhat anterior, surface marked by the fine elevated concentric lines characterizing so many species of this genus and with a very low posterior sulcus. Muscle scars slightly buttressed by shelly ridges.

*Locality.* Presque Isle stream.

### Palaeoneilo sp. ?

Plate 28, figures 15, 16

A small highly arched and very short species with projecting umbone.
*Locality.* Presque Isle stream.

### Nuculites cf. oblongatus Conrad and ellipticus Maurer

Plate 28, figure 11

The single observed specimen of this genus is very similar to either of the cited species (which may prove to be identical), one from the Hamilton fauna of New York, the other from the Coblentzian of the Rhine.
*Locality.* Edmunds Hill.

### Nucula cf. krachtae A. Roemer

Plate 28, figures 17, 18

Nucula krachtae A. Roemer. Verstein. des Harzgebirges, 1843. p.23, pl. 6, fig. 10
Nucula krachtae Beushausen. Lamell. des rhein. Devon. 1895. p.47, pl. 4, fig. 20
Nucula cf. krachtae A. Roemer. Clarke. N. Y. State Mus. Bul. 107. 1907. p.232

I am disposed to identify with this well known Coblentzian species a small trihedral Nucula of great obliquity and prominent overarching beaks.
*Locality.* Presque Isle stream.

### Palaeosolen cf. simplex Maurer

Plate 28, figures 1-4
*See* p. 77

Quite a common species is a small shell of the genus Palaeosolen having narrow elongate ensiform valves clearly gaping at the anterior extremity. The umbonal ridge is not sharp, but the postumbonal slope is crossed by direct vertical lines which are more prominent than those on the lateral slopes. Radial lines on the posterior slopes are very obscure. The valves so far seen are always in conjunction. I bring this shell into comparison with Maurer's P. simplex from the lower Coblentzian,[1] although it is somewhat more strongly marked posteriorly.
*Locality.* Presque Isle stream.

### Cypricardella sp.

Plate 28, figure 5

A small tenuous shell, oblique oval in form, represents a species not completely known.
*Locality.* Presque Isle stream.

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[1] *See* Maurer, Fauna des rechtsrhein. Unterdev. 1886. p.18; Beushausen, *op. cit.* p.224, pl. 18, fig. 9, 10. Maurer, Quartzit von Neuweilnau. 1902. p.62, pl. 4, fig. 13.

### Conocardium cf. inceptum Hall

Plate 28, figure 19

This is a small shell and we have seen only a single internal cast which affords characters justifying comparison with the specimens provisionally identified with this name from the Oriskany of Becraft mountain.[1] The surface of the shell bears 13 to 14 plications, an abrupt but not deep anterior slope. Conocardium inceptum was described from the Helderbergian (New Scotland) beds of Albany county, N. Y.[2] The species may also be compared with C. incarceratum of the Dalhousie fauna.

*Locality*. Edmunds Hill.

### Camarotoechia dryope Billings

Plate 30, figure 1

*Localities*. Edmunds Hill. Also in the Grande Grève limestone.

### Camarotoechia sp.

Plate 30, figure 2

*See* pt 1, p. 170

*Locality*. Edmunds Hill.

### Rensselaeria atlantica Clarke

Plate 29, figures 1-18

Rensselaeria mainensis Williams. U. S. Geol. Sur. Bul. 165. 1900. p.80, not described or figured

Rensselaeria atlantica Clarke. N. Y. State Mus. Bul. 107. March 1907. p.243

Rensselaeria mainensis Williams. U. S. Nat. Mus. Proc. April 1907. 32:267

The Rensselaerias of the Chapman Plantation faunas are of singular interest for the type of structure they present. They occur both in the Presque Isle stream outcrops and at Edmunds Hill but there is a difference in the forms from the two localities which is expressible in terms of development only.

These shells have a subnaviculoid contour, that is, the ventral valve is highly arched and elevated medially, the beak conspicuous and overarching the hinge, the lateral slopes of this valve abrupt while the dorsal valve is but gently convex, its beak being so depressed that it is obscure and the valve has a shouldered appearance on account of the broad regular convexity across the posterior part, from which there is a gentle slope anteriorly. The marginal outline is subcircular. In the more progressed type expressed in

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[1] N. Y. State Mus. Mem. 3. 1900. p.37, pl. 4, fig. 21–23.

[2] Hall, Palaeontology of N. Y. 1859. 3 : 491 (not figured).

the Presque Isle outcrops the large and thickened hinge plate is fully developed and was completely perforated at maturity. Likewise the strong adductor muscle scars separated vertically by a low septal ridge have quite the expression they display in fully developed specimens of R. ovoides and they even show the peculiar divergent vascular markings over the posterior slopes which have been heretofore recorded only in a single example of R. ovoides [Palaeontology of N. Y. v. 8, pt 2, pl. 75, fig. 5].

These are structural features important to emphasize, for no other species thus far described reproduces these details of that well known Oriskany shell so well. In the ventral valve, also, mature shells bear the expression of R. ovoides in their fully developed dental lamellae and deep pedicle pit. The shells of this species in early stages are transverse or subcircular rather than elongate, the increase of length being an acquisition of later growth. The hinge line is straight and extends for the full diameter of the shell giving the latter a semicircular outline.

On both ventral and dorsal valves a distinct and prominent cardinal area is present. The straight hinge line extending for nearly the entire width of the valve makes this a conspicuous feature, on the dorsal valve the area maintaining its notable width to the extremity of the cardinal line and then quickly losing it on the hinge angles. In the ventral valve this feature is made more prominent by the greater elevation of the beak and consequent greater width of the area.

To a certain degree this structure is comparable to that observed in the subgenus Beachia H. & C. (type, R. suessana Hall, Oriskany, Cumberland, Md.). In this shell "the cardinal margin beneath the beak [of the ventral valve] is flattened into a well defined pseudoarea" [Pal. N. Y. v. 8, pt 2, p. 259]. Here, however, is a high development of a cardinal area to a degree far beyond that expressed in Beachia. Furthermore in Beachia "the short inflection of the margin beginning here [on the hinge line] is continued along the lateral portion of the shell where it meets a similar marginal inflection from the opposite valve. These produce the sharp introversion of the lateral margins which is also one of the characteristics of the genus Megalanteris." No such reentrant margins occur in the shells under consideration. I would not refer the species to the subgenus Beachia lest thereby its real affinities be obscured.

The kindness of Prof. E. Kayser of Marburg has enabled me to compare my material with typical examples of the Rensselaerias, R. strigiceps F. Roemer and R. crassicosta (Koch) Kayser, of the lowest arenaceous Devonic of the Rhine, and my lamented friend, the late Dr L. Beushausen of the Landesanstalt, Berlin, compared some specimens from the Presque Isle stream fauna with examples of the species mentioned, in the collections of that institution.

The evidence at hand is very clear that while the specimens currently

referred to R. strigiceps are quite variable in degree of surface striation, yet this species also bears a cardinal area upon the valves. This feature is particularly well shown by a valve from the Taunus quartzite of Katzenloch near Idar in the Rhine province. In the main the specimens of this species are somewhat more finely striated than those from the Presque Isle but this is a difference notable only in the older shells where by obsolescence of the lateral striae the riblets become apparently less.

An internal cast of R. strigiceps, somewhat distorted, from the Siegen greywacke at the iron mine Alte Mahlscheid near Herdorf illustrates the immature character of certain of the generic structures. Thus the hinge plate and cardinal process are thin and not perforated, the dental plates and pedicle pit rather inconspicuous and the muscular impression not sufficiently strong to eradicate the marks of the shell plications. Such an expression of these structures is immature in the sense that they characterize this primary manifestation of species of Rensselaeria. This is their expression, for example, among the species of the Helderbergian fauna. On the other hand the Rensselaerias from Presque Isle stream are in these respects up to the full development of the type of the genus, R. ovoides. These characters in such condition do not therefore indicate a primitive phase nor an early stage in the history of the genus.

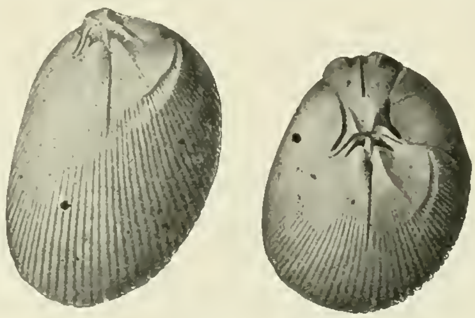
The shells from Edmunds Hill are of more primitive expression, especially in hinge structure, the plate not being thickened though well developed and separated medially or perforated, in this respect having the structure of the early species of the genus, such as occur in abundance in the beds of the Helderbergian of New York. This shell is in a general way smaller and carries within itself the expression of retarded development with reference to the larger forms at Presque Isle. I will not venture the statement that the small forms do not occur at Presque Isle but the larger have not been observed at Edmunds Hill.

The similarity of these smaller forms with the R. stewarti of Dalhousie is very close yet it seems to me improper to unite the shells, for such union would lead to the identification of the still simpler Dalhousie shell with the progressed form from Presque Isle. At Dalhousie the species seems to have become fixed in its primitive details; conditions in the Chapman Plantation region have permitted progress beyond the expression of R. stewarti.

The especial expression of the generic type of Rensselaeria afforded by these two closely allied species is repeated in the shell R. portlandica Billings from the Square Lake limestone of Maine. The last opportunity which the writer had for critical examination of the type of this species was while studying an extensive series of Rensselaeria and brachiopods allied thereto, in the preparation of *Palaeontology of New York*, volume 8, part 2. It was then observed that the species Terebratula gaudryi

d'Orbigny, the type of Bayle's genus Trigeria, was probably present in the Oriskany fauna of Maryland. This is a strongly plicated rensselaeroid, throughout of similar aspect to these under consideration save in minor details. To the same group R. portlandica belongs and in the work cited was referred to the genus Trigeria.

The genus Trigeria means a strongly plicated rensselaeroid with the hinge plate in an elemental condition, i. e. perforated, but with cardinal process slightly developed if present at all, and a cardinal area more or less distinctly retained on both valves. The genus stands to Rensselaeria (R. ovoides) in the relation of a neanic to an ephebic condition. R. atlantica, in its progressed expression even though retaining the primitive structure of the cardinal areas, can not be brought within that group, and Trigeria can not be construed as a valid generic term in the face of the facts here adduced.



Rensselaeria strigiceps Roemer. Dorsal and cardinal views. Siegen greywacke, near Herzdorf

In the closest alliance with the Edmunds Hill and Dalhousie shells are specimens which I have received from Prof. E. Kayser labeled R. strigiceps Roem. from the Siegen greywacke, at Siegen (Coblentzian). Though the shell is persistently smaller than those referred to, it is of the same contour, degree of plication and interior structure, emphasizing again the "Trigeria" characters. Precisely what is the relation of this small form from Siegen to the large, elongate, more characteristic examples of R. strigiceps from the Taunus quartzite at various localities which bears so strong a resemblance to R. atlantica, the writer is not in position to say, but it may prove to be the same as that we have here indicated.

### Rensselaeria nov.

Plate 29, figure 19

A large convex subcircular ventral valve presents a distinct departure from the other forms of the fauna in its shape and very finely lineate surface.

*Locality*. Edmunds Hill.

## SPIRIFER

The recent labors of Kayser, Drevermann and Scupin have done much to clear up the difficulties of identification among the many species of German Lower Devonic Spirifers. Too often among the earlier writers on

these bodies, a species of Spirifer was a fossil in a certain condition of preservation or from a special locality; these facts added to the usually execrable condition of the specimen, the disposition (not yet extinct) to construe a species from internal casts and to neglect the quite as essential and determinative exterior qualities have conspired to make comparisons extremely difficult. With the better knowledge of the present the way is less insecure.

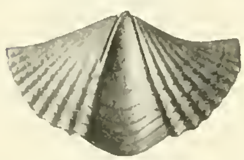
### Spirifer subcuspidatus Schnur var. lateincisus Scupin

Plate 30, figures 15-19

Spirifer subcuspidatus var. lateincisa Scupin. Die Spirif. Deutschlands, p.19, pl. 1, fig. 13, 14. Palaeontolog. Abhandl. 1900. v. 8

Spirifer subcuspidatus lateincisus Scupin. Clarke. N. Y. State Mus. Bul. 107. 1907. p.254

Under this term is separated by the writer quoted, certain shells which have heretofore passed as S. hystericus Schloth., among them those identified by Beushausen from the Spirifer sandstone of the Kahleberg. It is with these shells, many of which were collected by the writer in the Hartz when in company with the late Professor Beushausen, and which are now before me bearing his label, that I undertake to identify the Spirifer prevailing at Presque Isle stream. The critical feature from which the varietal term here used is derived is the long and divergent dental plates of the ventral valve, lateincisus being a term which has no significance in application to the organism but only to its mechanical surroundings. This Spirifer is a form not represented in the Appalachian Devonic; comparisons therewith are thus needless. Agreement with the specimens from Hahnenklee and Ramelsberg in the Hartz is found in the following particulars:



Spirifer subcuspidatus var. lateincisus Scupin. Internal cast of ventral valve showing divergent dental plates, x1½. Schaike, Hartz

1 *Size.* The average in this respect is slightly larger for the adult German specimens.

2 *Outline.* The hinge is not extended; cardinal angles not produced and less than or equal to 90 degrees. The margins are gently rounded and gradually approximate to the front. The cardinal area is moderately high and slightly curved making an arched ventral valve.

3 *Plication.* The median sinus in each has the width of five to six lateral furrows. The lateral plications are eight to nine on each side of fold and sinus and they are narrow, round, separated by furrows of similar width. The concentric markings are growth lines which may show a tendency to rugosity near the front.

4 *Fold and sinus.* The sinus is moderately deep and angulated. It is

more sharply angulated on the Maine specimens; in some of the German specimens this angulation is apparent only in later growth. The fold is the counterpart in these characters.

5 *Internal characters.* Most notable independently and in point of agreement are the very long dental plates, which diverge rather more in the German than in the American form. In the Hartz specimens these plates lie uniformly in the first radial grooves and hence diverge at the angle of divergence of the radii. In the American shells they are quite as uniformly subparallel to each other and thus are not parallel with the radii but transect the proximal end of first sulcus and plication. This is a slight but persistent difference. The muscle area in both shells is but faintly defined on the ventral valve.

*Locality.* Presque Isle stream.

### Spirifer cymindis Clarke

Plate 30, figures 6-8, 10, 11

Spirifer cymindis Clarke. N. Y. State Mus. Bul. 107. 1907. p.255

This is a shell belonging to an extensive group of early Devonic species which I presume are all minutely fimbriate (as in S. concinnus Hall) though not in all have the surface characters been fully determined. Distinctions are refined in this series of fossils and the differentials of the shells before us can best be indicated by comparisons with other members of this series.

In a general way, however, it may be said that S. cymindis is a shell of larger size and stouter proportions than S. subcuspidatus lateincisus. The form is short-winged with a prominent and arched ventral beak, well developed subangular median sinus and fold, the width of the former equaling the distance between three to four radial furrows; of the latter that of three plications. Both sinus and fold have abruptly sloping sides and a narrow bottom and top. The primary plications are conspicuous by their elevation beyond the rest. The radial plications are rounded on the exterior with sharp and narrow furrows, sharper on the internal cast with broader furrows. There are seven to eight plications on each lateral slope. In rare instances there is a faint median plication in the sinus. Fine concentric growth lines with traces of fimbriae cover the surface.

The dental lamellae are short, divergent and inconspicuous, the muscle scar of the ventral valve small, well defined, deeply divided by the median sinus. The shell is not greatly thickened about this area and the inner surface adjoining is rarely pustulose.

*Comparisons.* S. concinnus Hall. In this Helderbergian and Dalhousie form we have a shell of like proportions but with much more elevated ventral beak and broader cardinal area, more abundant plication, 10 to 12, greater width of fold and sinus and extended projection of the sinus on the anterior margin.

This is the only American shell which affords satisfactory basis for comparison.

I am here again indebted to Professor Kayser and Dr Drevermann for affording facilities and suggestion for comparison with European species of the early Devonic.

S. arduennensis Schnur [*see* Schnur. Brachiopoden der Eifel; Palaeontographica. 1854. 3: 199, pl. 32, fig. 3; Kayser. Fauna des Hauptquarzits. 1889. p.33, pl. 2, fig. 1–4; pl. 9, fig. 3; pl. 12, fig. 5; pl. 16, fig. 1–9].

This species with which I was at first disposed to identify the shells in hand is usually of small extended form with a very regularly convex ventral valve and broadly rounded plications. Though distinct in outline and contour it often represents the aspect in external and internal surface of S. cymindis.

S. decheni Kayser [*see* Kayser. Fauna d. aeltest. Devon-Ablag. des Harzes. 1878. p.165, pl. 22, fig. 1, 2].

This is a very large species but its smaller expressions, of which I have specimens from the Kellerswald, are like S. cymindis in degree of plication, though here it is the second rather than the first pair of lateral plications that dominates the rest. The ventral valve is uniformly convex but the umbo is not strongly arched.

S. nerei Barrande [as identified by Walther]. Specimens from the upper Coblentzian of Marburg very like this shell in general aspect are somewhat more numerously plicated but a distinctive feature lies in the very long dental plates such as are present in S. lateincisus.

*Locality*. Edmunds Hill.

## Spirifer cymindis var. sparsa Clarke

Plate 30, figures 12–14

Spirifer cymindis var. sparsa Clarke. N. Y. State Mus. Bul. 107. 1907. p.257

Associated with S. cymindis and quite as abundant, is a shell distinguished in gross by its sparser plication. Our material here presents us chiefly with a series of internal casts in which there are some differences of expression, noted in particular in the following enumeration:

1 *Size*. The shells are of medium size, uniformly approaching S. arduennensis and S. cymindis in dimensions. Differences in size and age are expressed on the internal cast by a clearer definition in the younger and thinner shelled examples.

2 *Outline and contour*. The marginal outline is subtriangular, the hinge being long and sometimes extended at the angles, the lateral margins rather directly convergent. The ventral valve is elevated at the beak, the cardinal area being rather high and curved, and the median part of the shell elevated.

3 *Surface.* The median sinus has a width of from two to two and one half lateral furrows, its sides being highly divergent, sloping abruptly to the bottom which is sometimes quite sharp. The primary plications are conspicuous and elevated. On the sides there are four, rarely five, plications, in extreme cases greatly subordinated to the median ones and separated by broad furrows. The sculpture of the surface consists of rather coarse and moderately distant concentric lines which may become lamellose.

4 *Interior.* The dental plates are as in S. cymindis. The muscle scar of the ventral valve is deeply impressed and sharply defined, specially in old shells where the test is thickened in the umbonal region. The removal of this thickened shell leaves internal casts with a prominent muscle area, the surfaces adjoining which are pustulose. There is no median septum in this valve. In young shells the ribs are sharp on the internal cast but are rounder on old shells.

The features here summarized constitute an expression not represented in the Appalachian faunas and so far as we can ascertain not exactly reproduced in the Coblentzian.

*Locality.* Edmunds Hill.

### Spirifer aroostookensis Clarke

Plate 30, figures 5, 9; pl. 34, figures 6–16

*See* p. 143

Spirifer aroostookensis Clarke. N. Y. State Mus. Bul. 107. 1907. p.258

This shell is characterized by its broad, flat ribs with very narrow radial furrows, in which respect it is remarkably similar to S. mesastrialis Hall of the Upper Devonic (Ithaca group) of New York. Of these lateral ribs there are 10 to 12 on each side and each of the large ones bears a slight furrow along its flat top. The median fold is relatively narrow and not highly elevated. The shell is short-hinged and rotund in form. The surface is covered with close concentric fimbriate lines which bend backward at the middle of each sulcated rib. I have seen but a single dorsal valve of this interesting species but its differential characters are very distinct. As noted on page 143 of this volume, this species has proven to be common in recently discovered outcrops of the Oriskany in New York.

*Locality.* Edmunds Hill.

### Spirifer macropleuroides Clarke

Plate 30, figures 3, 4

Spirifer macropleuroides Clarke. N. Y. State Mus. Bul. 107. 1907. p.259

The Chapman Plantation fauna carries a representative of the Radiati or group of Spirifer **plicatellus** in a species which has the aspect

of a small Sp. macropleura Conrad,[1] an extreme expression of the form presented by S. togatus Barrande and variety subsinuata A. Roemer;[2] the first from the New Scotland Helderbergian of New York and the others from the lowest Devonic of the Hartz and Bohemia.

In S. macropleuroides the shell is more sharply plicate than in the others, the plications being two or three in number on each side of the median fold or sinus. Neither of the latter is extremely developed, being broad and regularly rounded; the lateral plications are strong and broad, evenly rounded and with narrow grooves. The surface is covered with very fine longitudinal striae. The shell is distinct from S. macropleura in its smaller size and stronger plications, in which respect it is the most progressed of all the three forms above mentioned.

*Locality*. Edmunds Hill.

### **Cyrtina** cf. **heteroclita** Defrance and **varia** Clarke

*Locality*. Edmunds Hill.

### **Meristella** sp.

There are apparently two species of Meristella present, one having the general aspect of M. laevis Hall (Helderbergian) the other much more elongate and narrow with an extremely long median septum on the dorsal valve. The material is meager and does not justify a further attempt at identification.

*Locality*. Edmunds Hill.

### **Nucleospira** cf. **elegans** Hall

Cf. Nucleospira elegans Hall. Palaeontology of New York. 1859. 3:222, pl. 283 fig. 10–15

An occasional specimen suggests this Helderbergian species.

*Locality*. Edmunds Hill.

### **Chonetes aroostookensis** Clarke

Plate 30, figures 20–25

Chonetes aroostookensis Clarke. N. Y. State Mus. Bul. 107. 1907. p.264

Shell transversely subrectangular, length to width as two to three, hinge line straight, making almost the full width of the shell; cardinal angles 90 degrees or a little more, the lateral margins expanding gently outward for a very short distance; lateral margins direct at first then broadly

[1] Hall. Palaeontology of N. Y. 1859. 3:302, pl. 27, fig. 1a–p; pl. 28, fig. 8a–d. Hall & Clarke. *ibid.* v. 8, pt 2, pl. 21, fig. 22–24, 27.

[2] Kayser. Aelt. Devon-Ablag. d. Harzes. pl. 21, fig. 3 and fig. 1, 2, 7.

curved to the anterior margin which is transverse. Ventral valve gently and quite uniformly convex, somewhat depressed to the cardinal angles. Cardinal area carrying a row of spines, five in number on each side of the beak, the outer ones attaining considerable length. Surface markings consisting of fine threadlike radii increasing rapidly by bifurcation, the striae and intervening grooves being of subequal size. There are three or four of these in 1 mm. A notable feature is the predominant size of the median stria on this valve. There are also suggestions of concentric or oblique undulation near the cardinal extremities. The surface sometimes shows a broad undefined depression with others at the side which may produce a gently undulated surface. This, however, is not a persistent feature. The dorsal valve is concave and on the interior shows a small bifurcate cardinal process flush with the cardinal area. The sockets and socket walls rest on a greatly thickened ridge just within the hinge line and subparallel to it. This notable ridge has an abrupt posterior slope leading down to the muscular area which is divided by three short and divergent ridges.

*Dimensions.* The average example has a length of 16 mm, width of 23 mm.

In seeking comparison of this very well defined species with allied forms we may note the following:

With Chonetes canadensis Billings of the Grande Grève fauna, it is more closely related than with any other, in outline and proportions. Like that it carries a conspicuous median stria. But the species are not to be confounded; C. aroostookensis is a stouter and heavier shell with a much coarser surface striation and a more convex ventral valve. It is less delicate and tenuous and never attains the notable dimensions of that species. With C. nova-scoticus Hall from the Arisaig series of Nova Scotia, it agrees in the development of the median stria but the resemblance there ceases. Chonetes latus v. Buch as identified by Sowerby from the Tilestones of Horeb Chapel, with which it has been compared, has not even remote relation with it. Davidson long ago pointed out that most of the Silurian Chonetes which had been referred to C. latus are identical with C. striatellus Dalman but he specially excepted the forms from Horeb Chapel. Neither the one nor the other presents any features for comparison here, the Tilestones shell being small, convex and minutely striate. C. sarcinulatus Schloth., from the Spiriferensandstein and other horizons of the Coblentzian is somewhat similar in form but is more evenly striate, without large median stria and is notably convex. Schnur's variety of this species, planus, from the same beds is little known but appears to be a shell of less width.

Of all the species of early Devonic age, C. falklandicus, Morris and Sharpe[1] presents the closest similarity though of smaller size and

[1] Quar. Jour. Geol. Soc. 1846. 2: 274, pl. 10, fig 4.

rather less subrectangular outline. One might with reason regard the Aroostook species a varietal expression of C. falklandicus. This species has been recently identified in the Bokkeveld beds of Cape Colony and figured by Reed[1] and these figures also show a narrower shell than that under discussion though attaining its full dimensions.

*Locality*. Common at Edmunds Hill.

Since describing the species as above I have received by courtesy of Dr E. H. L. Schwarz specimens of C. falklandicus from Montague, Cape Colony and on comparison of these with C. aroostookensis I find the differences above suggested fully expressed. The species are very closely related, both in size and matters of detail but the more elongate rectangular outline of the latter stands as a distinguishing character.

### Chonetes paucistria Clarke

Plate 30, figures 26, 27

Chonetes paucistria Clarke. N. Y. State Mus. Bul. 107. 1907. p.266

This is a rare shell associated with the foregoing, distinguished therefrom by the fewer and coarser striae, barely more than one half the number in C. aroostookensis, increase therein arising from implantation near the margins. The outline also is not subrectangular but subelliptical, the greatest width at the hinge and the margins converging quite rapidly in a broad curve. These differences are expressed in our figures.

*Locality*. Edmunds Hill.

### Anoplia nucleata Hall

This spineless chonetid, characteristic of the Oriskany and Decewville faunas, is not uncommon at Edmunds Hill.

### Stropheodonta cf. magniventer Hall

*See* pt 1, p. 184

There are fragments of a convex Stropheodonta bearing very long divaricator scars in the ventral valve, reaching almost to the margin. These suggest the species cited.

*Locality*. Edmunds Hill.

### Leptaena rhomboidalis Wilckens

*See* pt 1, p. 183; pt 2, p. 45

Characteristic examples of this species of medium size only, occur at Edmunds Hill.

[1] An. South African Mus. 1903. v. 4, pt 3, p.169, pl. 20, fig. 9, 10.

## Leptostrophia magnifica Hall protype parva Clarke

Plate 31, figures 5–9

*See* pt 1, p. 190

Leptostrophia magnifica Hall var. parva Clarke. N. Y. State Mus. Bul. 107. 1907. p.274

This shell may be best expressed in terms of the widespread L. perplana Conrad and L. blainvillii Billings, for it approaches these in all general features.

1 The surface striae, fine, threadlike and crowded, exhibit some diversity of size in early growth and this becomes intensified later so that about the margins there is either an inclination to irregular swelling or to fasciculation, the latter at times being quite pronounced. These are characters of L. magnifica not of L. perplana. Concentric wrinkles on the shell are altogether absent.

2 The cardinal area is denticulate to its extremities though narrow and but slightly cross striated ; the delthyrium is open.

3 The muscle scars are not greatly divergent but, as in L. magnifica, are contracted at the beginning though they extend more than halfway across the shell.

The shell is essentially a diminutive expression of L. magnifica, its fundamental structure being quite in harmony with it and its lesser variety tardifi from the Percé rock. In our material an occasional specimen indicates the presence of individuals larger than these we have figured. Dr Drevermann, after examination of these specimens, finds this shell closely approaching L. explanata Sowerby of the Coblentzian though that shell attains more nearly the dimensions of L. magnifica and has flatter rather than threadlike striae on the surface.

*Locality*. Edmunds Hill.

When we undertake a comparison with the Leptostrophias of the early Devonic which we have here considered, L. magnifica Hall (Oriskany and Grande Grève), L. magnifica tullia Billings (Percé), L. tardifi Clarke (Percé), L. magnifica parva Clarke (Chapman Plantation) with the prevailing Leptostrophia of the Coblentzian, L. explanata Sow., it is evident that we are dealing with essentially like quantities. It would be less difficult to express the last named in terms of any one of the others than in terms of them all. The original figure of this species [Geol. Trans. 2 ser. 1842, v. 6, pl. 38, fig. 15] is the clearest possible expression of the ventral interior of a rather small form of L. magnifica, hence of var. tullia or practically var. parva. That the species attains greater dimensions and broader muscle scars is evinced by Schnur's[1] and

[1] Brach. d. Eifel, pl. 39, fig. 6.

Kayser's[1] figures. There is no stable specific difference herein. All are expressions, with slight divergence and local persistence, of the L. explanata type.

### Orthothetes (Schuchertella) cf. deformis Hall

Plate 31, figures 1-4

*See* Orthis deformis Hall. Palaeontology of New York. 1859. 3:174, pl. 15, fig. 3
Orthothetes deformis Hall & Clarke. *Ibid.* 8:255

A very much distorted species of this genus with short hinge line, broad, much elevated cardinal area, similar in aspect to, though of smaller size than the species cited. This shell is known from a half dozen ventral valves all highly rugose, especially on the earlier parts of the shell, and some showing a large cicatrix of attachment which must have continued to comparatively late growth. Even the strongly developed deltidium is affected by the irregular growth.

The surface of these valves is sharply and closely striated.

*Locality.* Edmunds Hill.

### Hipparionyx minor Clarke

Plate 31, figures 16-22

Hipparionyx minor Clarke. N. Y. State Mus. Bul. 107. 1907. p.278

The recognized distinction between the genera Hipparionyx and Orthothetes or Schuchertella lies chiefly in the orthoid form of the former and its very short hinge line. In respect to this character the specimens before us are pronounced. The ventral valves, small in comparison with those of H. proximus, have a short and low cardinal area, but in the dorsal valves the hinge line is apparently longer than correspondence with the opposite valve requires and these valves convey the impression of a straight and tolerably long line extending more than one half the width of the shell. On examination of the inner surface of this valve it is seen that this area is really short and confined to the apical part of the valve while the extended extremities are a thin expansion of the lateral parts of the valve which make a rather sharp turn at the cardinal angles. There is other divergence in the shell away from the type of Hipparionyx and toward that of Orthothetes as represented by such shells as Streptorhynchus umbraculum Schlotheim and its variant expressions.

In further detail, the ventral valve is subcircular or transverse with strongly defined and thickened adductor and divaricator scars. These are not, however, as large as in H. proximus. The beak is convex and slightly elevated but the rest of the valve is depressed or flat with a tendency to turn up about the margin and with indications of a broad and low

[1] Fauna d. Hauptquarzits, pl. 21, 22, fig. 1.

median fold. The striae are sharply elevated, increase very rapidly by implantation and on the cardinal slopes curve forward, out and back, in very characteristic manner. Very fine concentric lines are visible in the intervals between the striae. The dorsal valve is highly convex, the beak is not prominent, the convexity is generally uniform with slightly depressed cardinal slopes and sometimes a trace of a median groove. On the interior is a strong bifid cardinal process and a short median septum.

*Locality*. Edmunds Hill.

### Dalmanella drevermanni Clarke

Plate 31, figures 10-12, 14, 15

Cf. Orthis tectiformis Walther. Neues. Jahrb. für Min. Beil. Bnd 17, 1903. p.164, pl. 3, fig. 4 a–c

Orthis circularis Sow. mut. postuma Frech. Lethaea Paleozoica. 1897. v. 2, pl. 24 b, fig. 8. *nom. nud.*

Orthis circularis Sow. D'Archiac & deVerneuil. Geol. Soc. Lond. Trans. 1842. v. 6, pl. 38, fig. 12 (*non auctorum*)

Orthis subcarinata Hall. Palaeontology of New York. 1859. 3 : 169, pl. 12, fig. 7–21

Dalmanella drevermanni Clarke. N. Y. State Mus. Bul. 107. 1907. p.286

This shell, the only one of its type in the fauna, is essentially a diminutive expression of Orthis subcarinata Hall of the New Scotland beds. It has affiliations, however, with other species, as cited above but the conditions of its occurrence oblige us to regard the form as wholly mature; though with reference to others its expression is immature. The exteriors of our shells indicate fine and somewhat unequal striation, with rapid multiplication of the sharp riblets, an almost flat dorsal valve with low broad median depression and a medially elevated ventral valve with broad not acute keel. It is closely similar to Orthis tectiformis Walther, as cited, from the upper Coblentzian of the Haiger.

*Locality*. Edmunds Hill.

### Orthis sp.

Plate 31, figure 13

Valves are present, but imperfectly retained, of a small Orthis having an aspect quite unlike any species of the Appalachian province.

Professor Kayser has called my attention to the close similarity of expression in this shell and the Orthis personata Zeiler of the Siegen greywacke. [*See* for illustration, Kayser. Beitr. zur Kenntn. d. Fauna d. Siegen. Grauwacke: Jahrb. d. königl. preuss. geol. Landesanst. 1892. pl. 11–12]

That is a uniformly larger species with rounder outline and I presume when this Maine shell is better known it will prove a specific departure from that somewhat peculiar orthid type.

*Locality*. Edmunds Hill.

### Orthis sp.

Cf. Orthis dorsoplana Frech. Lethaea Paleozoica. 1897. v. 2. pl. 23a, fig. 3

There are a few casts of ventral valves which have an unusually high cardinal area and open delthyrium bearing the contour of O. tectiformis except that this is exaggerated by the elevation of the beak. Indeed the aspect of the valve is almost that of Orthisina. Into comparison with this form may be brought the species cited above, from the upper Coblentzian of Haiger.

*Locality.* Edmunds Hill.

### Orthis sp. nov.

There are several internal casts of dorsal valves which are remarkable for their unusual aspect, viz, great length of hinge, deeply sulcate median region, divergent sockets and large muscle scars. The general outline of the shell is leptaenoid. The surface is radially striate. I have not ventured to identify these shells.

*Locality.* Edmunds Hill.

### Orbiculoidea cf. ampla Hall and siegenensis Kayser

Plate 31, figures 23, 24

This is a large species with elevated brachial valve which occurs freely but bears no distinguishing characters from the forms above cited, the former from the Oriskany of New York, the latter from the Siegen greywacke. Of the latter Kayser remarks [Jahrb. d. königl. preuss. geol. Landesanst. 1890. p.95, pl. 9, fig. 1, 2]: "I am acquainted with no species in the rhenish Devonic, at least in the Lower Devonic, which can be confounded with this. In fact there is only one Devonic Discina known to me which is in any way comparable in form and size. This is J. Hall's Discina grandis [ampla] from the Oriskany sandstone."

*Locality.* Presque Isle stream.

### Polypora cf. celsipora Hall

*See* Palaeontology of New York. 6:150, pl. 41, 42

*Localities.* Edmunds Hill. Very common in the Onondaga limestone of the Appalachian province.

### Hindia sp.

*Locality.* Edmunds Hill.

DISTRIBUTION OF THE CHAPMAN FAUNA

| SPECIES | Presque Isle | Edmunds Hill | Helderberg, N. Y. | Oriskany, N. Y. | St Alban | Grande Grève | Moose river | Dalhousie | Coblentzian |
|---|---|---|---|---|---|---|---|---|---|
| Asterolepis clarkii *Eastman* | | x | | | | | | | |
| Spirorbis *sp.* | x | | | | | | | | |
| Homalonotus vanuxemi *Hall* | | x | x | | | | x | | |
| Phacops *cf.* logani *Hall* | | x | x | x | | + | | | |
| P. (Phacopidella) nylanderi *Clarke* | | x | | | | | | | |
| Dalmanites *cf.* micrurus (*Green*) | | x | x | | | | | | |
| Beyrichia kloedeni *McCoy var.?* | x | | | | | | | + | |
| B. oculina *Hall* | | x | | | | | | | |
| Orthoceras norumbegae *Clarke* | | x | | | | | | | |
| Tentaculites scalaris *Schlotheim* | | x | | | | | | | x |
| Conularia *cf.* huntiana *Hall* | x | | x | | | | | | |
| Plectonotus *cf.* derbyi *Clarke* | x | + | | | | | x | | |
| Tropidodiscus obex *Clarke* | | x | | | | | x | | |
| Coelidium tenue *Clarke* | x | | | | | | x | x | |
| Eotomaria hitchcocki *Clarke* | x | | | x | | | | | |
| Holopea beushauseni *Clarke* | x | + | | | | | | | x |
| Platyceras leboutillieri *Clarke* | | x | | | | x | | | |
| P. hebes *Clarke* | | x | + | | | | | | |
| P. kahlebergensis *Beushausen* | | x | | | | | | | x |
| Loxonema *sp. cf.* funatum *A. Roemer* | | x | | | | | | | x |
| Pterinea *cf.* fasciculata *Goldfuss* | x | | | | | | | | x |
| P. radialis *Clarke* | x | | | | | | x | | |
| P. chapmani *Clarke* | | x | | | | | | | |
| P. edmundi *Clarke* | + | x | | | | | | | |
| *var.* subrecta *Clarke* | | x | | | | | | | |
| P. brisa *Clarke* | | x | | | | | | | |
| P. *sp* | | x | | | | | | | + |
| Pteronitella peninsulae *Clarke* | x | | | | | | | | |
| Pterinopecten aroostooki *Clarke* | | x | | | | | | | |
| Myalina pterinaeoides *Clarke* | x | | | | | | | | + |
| Modiomorpha vulcanalis *Clarke* | | x | | | | | | | + |
| M. protea *Clarke* | x | x | | | | | | | |
| M. *sp* | | x | | | | | | | |
| Grammysia modiomorphae *Clarke* | | x | | | | | | | + |
| G. *sp* | | x | | | | | | | |
| Leptodomus communis *Clarke* | x | | | | | | | | |
| L. corrugatus *Clarke* | x | | | | | | | | |
| Palaeoneilò orbignyi *Clarke* | x | | | | | | | | |
| P. mainensis *Clarke* | x | | | | | | | | + |
| P. circulus *Clarke* | x | | | | | | | | |
| P. *sp?* | x | | | | | | | | |
| Nuculites *cf.* oblongatus *Conrad* and ellipticus *Maurer* | | x | | | | | | | + |

DISTRIBUTION OF THE CHAPMAN FAUNA (*continued*)

| SPECIES | Presque Isle | Edmunds Hill | Helderberg, N. Y. | Oriskany, N. Y. | St Alban | Grande Grève | Moose river | Dalhousie | Coblentzian |
|---|---|---|---|---|---|---|---|---|---|
| Nucula *cf.* krachtae *A. Roemer* |  | x |  |  |  |  |  |  | x |
| Palaeosolen *cf.* simplex *Maurer* | x |  |  |  |  |  | x |  | x |
| Cypricardella *sp* | x |  |  |  |  |  |  |  |  |
| Conocardium *cf.* inceptum *Hall* |  | x | x |  |  |  |  | + |  |
| Camarotoechia dryope (*Billings*) |  | x |  | + |  | x |  |  |  |
| C. *sp* |  | x |  |  |  |  |  |  |  |
| Rensselaeria atlantica *Clarke* | x | x |  |  |  |  |  | + | + |
| R. *n* |  | x |  |  |  |  |  |  |  |
| Spirifer subcuspidatus *Schnur v.* lateincisus *Scupin* | x |  |  |  |  |  |  |  | + |
| S. cymindis *Clarke* |  | x | + |  |  |  |  |  | + |
| *v.* sparsa *Clarke* |  | x |  |  |  |  |  |  | + |
| S. aroostookensis *Clarke* |  | x |  | x |  |  |  |  |  |
| S. macropleuroides *Clarke* |  | x | + |  |  |  |  |  |  |
| C. *cf.* heteroclita *Defrance* and varia *Clarke* |  | x |  |  |  |  |  |  |  |
| Meristella *sp* |  | x |  |  |  |  |  |  |  |
| Nucleospira *cf.* elegans *Hall* | x | x | x |  |  |  |  |  |  |
| Chonetes aroostookensis *Clarke* |  | x |  |  |  | + |  |  | + |
| C. paucistria *Clarke* |  | x |  |  |  |  |  |  |  |
| Anoplia nucleata *Hall* |  | x |  | x |  |  |  |  |  |
| Stropheodonta *cf.* magniventer *Hall* |  | x |  | x |  | x |  |  |  |
| Leptaena rhomboidalis *Wilckens* |  | x | x | x | x | x |  | x |  |
| Leptostrophia magnifica *Hall prot.* parva *Clarke* |  | x |  | x |  | x |  |  |  |
| Orthothetes (Schuchertella) *cf.* deformis *Hall* |  | x | x |  |  |  |  |  |  |
| Hipparionyx minor *Clarke* |  | x |  | + |  | + | + |  |  |
| Dalmanella drevermanni *Clarke* |  | x |  |  |  |  |  |  | + |
| Orthis *sp* |  | x |  |  |  |  |  |  | + |
| O. *sp* |  | x |  |  |  |  |  |  | + |
| O. *sp. nov* |  | x |  |  |  |  |  |  |  |
| Orbiculoidea *cf.* ampla *Hall* and siegenensis *Kayser* | x |  |  | x |  | + |  |  | + |
| Polypora *cf.* celsipora *Hall* |  | x |  |  |  |  |  |  |  |
| Hindia *sp* |  | x |  |  |  |  |  |  |  |
| Total 73 | 24 (1) | 52 (2) | 8 (3) | 8 (2) | 1 | 5 (4) | 6 (1) | 2 (3) | 7 (15) |

## THE EARLY DEVONIC IN EASTERN NEW YORK

When Professor Hall was elaborating the paleontology of the Helderberg and Oriskany formations, the development of these rocks in the Appalachian region of New York south of the Helderberg mountains did not contribute materially to his stores. The outcrops in this region had been delineated with approximate accuracy by Mather, but in all his paleontological work in New York Hall seldom got far away from the undisturbed rocks of the central and western districts of the State to which he was early wedded. Work was later done in this Appalachian region by N. H. Darton and by Dr Heinrich Ries. The latter constructed a map and report of Orange county recording interesting data in regard to details of stratigraphy without attempting close analyses on the basis of paleontology. In these instructive but somewhat involved eastern sections entangled in Appalachian folding, the arenaceous deposits of the Lower Devonic have generally passed as "Oriskany" and the calcareous beds beneath as "Lower Helderberg," designations which are no longer accurate or adequate. Since 1890 these regions have been given careful study at certain points and the succession of the faunas closely analyzed. The first of these special studies was that of the Oriskany fauna of Becraft mountain, the sole outlier of this stage east of the Hudson river. This was followed in the year 1903 by two important contributions, one by Dr Stuart Weller on the *Paleozoic Rocks and Faunas of New Jersey* in which he discussed the sections at the entrance of the western or Port Jervis-Otisville branch of the divided paleozoics of eastern New York and those further south in his own state; another by Prof. Gilbert van Ingen and P. E. Clark on the *Disturbed Fossiliferous Rocks in the Vicinity of Rondout, N. Y.* [Mus. Bul. 69] in which all the precise determinations were made by Mr van Ingen. In 1904 Prof. H. W. Shimer published the paleontology of the section at Port Jervis known as Trilobite mountain [Upper Siluric and Lower Devonic Faunas of Trilobite Mountain, Orange County, N. Y.; Mus. Bul. 80].

Prof. George H. Chadwick has recently brought together the results

of some further examinations, made for the State Museum, of the sections at Rondout and southward into Greene county with the especial aim of elucidating the composition of that element of the Helderbergian group known as the Port Ewen fauna, and though these results have not been put in final form I have availed myself of the author's permission to refer to some of his determinations. More lately the progress of field work has developed a quite novel aspect of the Oriskany fauna in sections at Highland Mills, Orange county, in an area on the east of Skunnemunk mountain where the presence of these rocks had not before been accurately determined. This section with its contents will presently be noticed, but it is desirable just here to summarize our present knowledge of the earlier or Port Ewen fauna.

**Port Ewen beds.** To rehearse briefly the history of this stratigraphic unit, these are a series of thin limestones and gray lime shales which, in the Appalachian region of New York and New Jersey, lie immediately on the Becraft limestone, bear the lithic character of the New Scotland lime shale and carry a large percentage of Helderberg fossils. It is a division not recognized by the early geologists of New York in their partition of the "Lower Helderberg" and it is entirely absent from the succession west of Schoharie. Its earliest recognition as a distinct unit was by Prof. W. M. Davis who in discussing the structure of the Little Mountains east of the Catskills [Appalachia 3. 1882; Am. Jour. Sci. 1883. ser. 3, 26:389] termed these rocks whose position he determined as above the Becraft limestone the "Upper shaly beds" contrasting them in this designation with the "Catskill or Delthyris shaly limestone" below. Professor Davis did not attempt to delimit the beds and did actually, according to Professor Chadwick, include in his division some part of the "Upper Pentamerus" (Becraft) limestone. In a joint publication with Professor Schuchert [Science. 1899; also in N. Y. State Mus. Mem. 3. 1900] the writer recognized the distinct unit character of these beds and termed them the "Kingston beds," later [Handbook 19, 1903] substituting for this term which proved to have been previously employed by the Canadian geologists for a quite different formation, the name Port Ewen

beds. These writers regarded this unit as pertaining to the Helderbergian group. In Memoir 3 the thickness of these beds was given in a section at Rondout measured by Messrs van Ingen and Ruedemann as 225 feet and a fauna was determined which contained only species of the Helderbergian units beneath. These determinations are indicated in the summary list of the fauna given below. The distinctive characters of the Port Ewen formation in this section have been excellently described by van Ingen [N. Y. State Mus. Bul. 69] and he too in his species list cited no fossils which could be regarded as other than surviving Helderberg species. Mr Chadwick's field of observation has covered not only this but a more extended region southward. His studies involve a reexamination of the type section with additional sections at Cottekill, on Catskill creek and elsewhere. He has brought together a list of the leading species in the basal beds of the Port Ewen formation in which he has determined not only a much larger number of species than before known, but among them finds a noteworthy percentage of species that may be regarded as normal to the calcareous or Becraft Oriskany. Various others have been recognized as passing upward from the Helderbergian into this Oriskany and in his close analyses of the assemblage Mr Chadwick points out its decadent condition as a Helderberg fauna. Mr Chadwick's studies have not as yet extended to the exact determination of the higher faunas. Mr Shimer's determinations of the Port Ewen fauna at Port Jervis include the species Spirifer murchisoni, Meristella lata, forms entirely diagnostic of the Becraft Oriskany.

The following table presents the sum of our present knowledge of the Port Ewen fauna, the letters before each name indicating the responsible authority for the determinations (C=Clarke, Ch=Chadwick, G=Grabau, S=Shimer, V=van Ingen) and indicates the range of the species from the Helderbergian below and upward into the Oriskany; also their representation in the eastern Atlantic faunas of this time.

| | PORT EWEN FAUNA | Helderbergian 1 | St Alban 2 | Dalhousie 3 | Grande Grève 4 | Oriskany 5 |
|---|---|---|---|---|---|---|
| | **Annelids** | | | | | |
| *CV* | Tentaculites elongatus *Hall* | x | | | x | x |
| | **Trilobites** | | | | | |
| *CV* | Ceratocephala tuberculata (*Conrad*) | x | | | | x |
| *CV* | Dalmanites pleuroptyx *Green* | x | | | | |
| *S* | Dalmanites *sp.* | | | | | |
| *CV* | Homalonotus vanuxemi *Hall* | x | | | | |
| *CV* | Phacops logani *Hall* | x | x | | x | x |
| | **Gastropods** | | | | | |
| *G* | Orthonychia *cf.* tortuosa *Hall* | | | | x | x |
| | **Pelecypods** | | | | | |
| *CSV* | Cypricardinia lamellosa *Hall* | x | | | | |
| | **Brachiopods** | | | | | |
| *Ch* | Camarotoechia acutiplicata *Hall* | x | | | | |
| *Ch* | Uncinulus abruptus *Hall* | x | | | | |
| *CChV* | U. campbellanus *Hall* | x | | | | |
| *CV* | U. mutabilis *Hall* | x | | | x | |
| *Ch* | U. nobilis *Hall* | x | | | | |
| *Ch* | U. pyramidatus *Hall* | x | | | | |
| *Ch* | U. vellicatus *Hall* | x | x | | | |
| *Ch* | U. ventricosus *Hall* | x | | | | |
| *CV* | Eatonia medialis (*Vanuxem*) | x | | | | x |
| *CChGV* | E. peculiaris (*Conrad*) | x | | | x | x |
| *ChS* | E. singularis (*Vanuxem*) | x | | | | |
| *ChV* | Anastrophia verneuili *Hall?* | x | | | | |
| *Ch* | Rensselaeria subglobosa *Weller* | | | | | |
| *G* | R. *sp.* | | | | | |
| *Ch* | Beachia suessana *Hall* | | | | | x |
| *Ch* | Megalanteris ovalis *Hall* | x | | | | x |
| *Ch* | Spirifer arenosus *Conrad* | x | | | x | x |
| *ChGV* | S. concinnus *Hall* | | | x | | |
| *CChGV* | S. cyclopterus *Hall* | x | | | x | |
| *Ch* | S. macropleura *Conrad* | x | | | | |
| *CChV* | S. modestus *Hall* | x | | | | |
| *S* | S. murchisoni *Castelnau* | | | | x | x |
| *CChGV* | S. perlamellosus *Hall* | x | | x | x | |
| *Ch* | Cyrtina rostrata *Hall* | | | | x | x |

| | PORT EWEN FAUNA | Helderbergian 1 | St Alban 2 | Dalhousie 3 | Grande Grève 4 | Oriskany 5 |
|---|---|---|---|---|---|---|
| *Ch* | Meristella bella *Hall* | x | | | | |
| *CChV* | M. laevis *Hall* | x | x | | | |
| *S* | M. lata *Hall* | | | | x | x |
| *Ch* | M. princeps *Hall* | x | | | | |
| *Ch* | M. vascularia *Clarke* | | | | | x |
| *CChV* | Atrypa reticularis *Linné* | x | x | | | |
| *CChSV* | Coelospira concava *Hall* | x | | | x | |
| *V* | Nucleospira elegans *Hall* | x | | | | |
| *Ch* | N. ventricosa *Hall* | x | x | | x° | |
| *Ch* | Trematospira perforata *Hall* | x | | | | |
| *Ch* | Leptocoelia flabellites *Conrad* | | | | x | x |
| *G* | Rhynchospira formosa *Hall* | x | x | | | |
| *Ch* | Leptaenisca concava (*Hall*) | x | | | | |
| *CChGV* | Leptaena rhomboidalis *Wilckens* | x | x | x | x | x |
| *CChSV* | Leptostrophia becki *Hall* | x | x | | | x |
| *G* | L. magnifica *Hall* | | | | | x |
| *Ch* | L. oriskania *Clarke* | | | | x | x |
| *Ch* | L. planulata *Hall*? | x | | | | |
| *ChG* | Orthothetes becraftensis *Clarke* | | | | x | x |
| *ChV* | O. woolworthanus *Hall* | x | | | x | |
| *Ch* | Brachyprion ma or *Clarke* | | | x | x | x |
| *Ch* | B. schuchertanum *Clarke* | | | | | x |
| *SV* | Strophonella leavenworthana *Hall* | x | x | | | |
| *CChSV* | S. punctulifera (*Conrad*) | x | x | x | | |
| *Ch* | Schizophoria multistriata *Hall* | x | | | | |
| *Ch* | Rhipidomella discus *Hall* | x | | | | |
| *CChV* | R. oblata *Hall* | x | | | | x |
| *S* | Dalmanella concinna *Hall* | x | | | | |
| *ChV* | D. perelegans *Hall* | x | | | | x |
| *CChV* | D. planoconvexa *Hall* | x | | | | x |
| *Ch* | D. quadrans *Hall* | x | | | | |
| *CSV* | D. subcarinata *Hall* | x | x | | | |
| *CV* | Pholidops ovatus *Hall* | x | x | x | x | |
| *Ch* | Crania pulchella *H. & C* | x | | | x | x |
| *S* | Lingula *sp* | | | | | |
| | **Bryozoa** | | | | | |
| *S* | Lichenalia torta *Hall* | x | | | | |
| *G* | Monotrypella tabulata *Hall* | x | | | | |

| | PORT EWEN FAUNA | Helderbergian 1 | St Alban 2 | Dalhousie 3 | Grand Grève 4 | Oriskany 5 |
|---|---|---|---|---|---|---|
| | **Corals** | | | | | |
| *S* | Enterolasma strictum (*Hall*) | x | | | | |
| *G* | Cladopora *cf.* styphelia *Clarke* | | | | | x |
| *CV* | Duncanella rudis *Girty* | x | | | | |
| *V* | Favosites helderbergiae *Hall* | x | | | | |
| *CV* | Pleurodictyum lenticulare (*Hall*) | x | | | | |
| *CV* | Zaphrentis roemeri *Hall* | x | | | | |
| | **Sponges** | | | | | |
| *CV* | Hindia fibrosa *Roemer* | x | x | x | | |
| | | 58 | 13 | 7 | 21 | 26 |

Not only is the continued predominance of Helderberg species in this summary, combined with the first appearance of Oriskany types, confirmatory of Professor Chadwick's view that the fauna is the passing phase of the Helderberg but it is in accord with our views of affiliation in the case of such clearly mixed combinations to assert that the presence of the later species indicating a new invasion is a proper index of Oriskany age.

**Oriskany fauna.** Considering now the composition of the more normal Oriskany fauna in this eastern region in the light of newer developments we are presented with the fact that there is yet no intimate distinction in the species from the calcareous beds and those which are distinctively arenaceous. The limestones of this horizon are all pretty highly impregnated with sand and their weathered parts always afford the best material for study either in the form of silica replacements or sharp external and internal casts in residual sand. The fauna at Becraft mountain reported by Clarke was obtained wholly from weathered residua of sandy limestone. The very fine material obtained at and about Glenerie occurs best as silica replacements, often of very remarkable perfection, in pockets filled with the loose sand of rotted limestone, in all respects a parallel occurrence to the fine

Silica replacements of ventral valves of Leptostrophia magnifica Hall from pockets of decomposed Oriskany limestone at Glenerie, N. Y. Introduced to show the perfection of preservation. The lower figure shows a circular perforation of the shell near the cephalic center of the brachiopod, probably made by the mollusk Diaphorostoma.

Oriskany material from Cumberland, Md. on which Hall based many of his original descriptions. At Pine Hill near Highland Mills the rock is a sand residuum without any calcareous cores even where exposed in a deep railroad cut, but it evidently has had a considerable lime content. In the Port Jervis section the Oriskany is a black limestone with its fossils in part silicified, and this is the character of rock that prevails in the extension of the horizon into New Jersey with sandstones lying at the top. Weller gives the Oriskany a thickness of 170 feet in New Jersey and speaks thus of the rocks: "These beds are for the most part silicious limestones, but at the summit of the formation in the southern half of the Wallpack ridge in New Jersey the higher beds are replaced by sandstones. With the southwestern extension of the formation into Pennsylvania the arenaceous facies becomes more and more conspicuous, the sandstones replacing lower and lower beds until the entire Oriskany formation is a sandstone continuous with the Stormville sandstone or conglomerate [N. J. Geol. Sur. Rep't. Pal. 3. 1903. p.93].

Some authors have been ready to find a basis for subdivisions of the Oriskany in this difference in the character of the sediment. Personally I have not felt constrained by this evidence. In the typical and highly fossiliferous Oriskany sands of central New York all trace of calcareous deposit is wanting and these sands have transgressed westward on a much eroded bottom of Helderberg limestones. The species of these sands are not particularly common in the more calcareous deposits of the east but none is absent. The western sands are the transgressing shore deposits of a late stage of Oriskany time. Were the limestones and sandstones always present in the eastern sections, even without variation in fauna they would form a stable basis for stratic division, but one or the other may be entirely absent from the section or the relations of the two quite inverted.

Dr Weller divides his Oriskany sections into three zones, Mr Shimer the Port Jervis section into two, Mr Chadwick designates the conglomerate beds at the base of the section near Rondout as the "Connelly conglomerate," the overlying limestone with its abundant fauna the "Glenerie limestone" and suggests the term "Port Jervis limestone" for Shimer's lower

division of the formation. These terms however useful locally must have a very restricted value in view of the rapidity of change of sediment in the oscillating coast line which received these deposits. While such divisions are practicable, I think we can not yet safely speak of a Lower Oriskany and Upper Oriskany, even in the face of certain paleontological differences indicated by Shimer in the Port Jervis section, the most effective of which is the presence of the trilobite Dalmanites dentatus in the lower zone only. In my memoir of 1900 [p.77] I expressed the view from the information then available, that the fauna of the D. dentatus zone was Helderberg (Port Ewen) age. I am prepared now to withdraw this view and recognize this zone as a proper part of the Oriskany section in accordance with the suggestion of Dr Barrett and the propositions of Messrs Weller and Shimer.

**Oriskany section at Highland Mills.** In order to bring together the composition of the Oriskany fauna as a whole as known in eastern New York outcrops, occasion is taken at this point to discuss the Pine Hill section at Highland Mills, Orange co.

This section lies along the new grade of the Erie Railroad just north of Highland Mills station[1] and extends somewhat beyond Woodbury Falls station. The succession here is a quite regular but somewhat faulted series constituting the eastern limb of a syncline which bends down beneath the Skunnemunk mountain at the west and comes up on the western slope of that mountain with loss or change of some minor details. Pine Hill is that part of the section constituting the hill just east of the Erie Railroad, which is bounded on both east, north and west sides by branches of the Woodbury creek which are confluent branches of the Moodna creek. The course of the hill has the general course of the strike of the rocks, ne.-sw. The lowest member of the series is the Cambric which lies or is faulted against the crystallines at the east, and the entire series on this limb of the syncline

[1] The section was first observed by Mr H. C. Wardell who has measured it with care and has collected freely of its fossils. This was possible during the construction of the road but with the completion of the cut access to the rocks has been effectively suspended.

up to and including the Hamilton (Bellvale) shales is cut off at the north by another downthrust against the crystallines, the east branch of the Woodbury creek following this fault line. This section was described by Dr Ries in his *Geology of Orange County* with approximate accuracy save for the details which better exposures have developed. What is here regarded as Oriskany and Schoharie grit was then indicated as "Helderberg" while we can not feel entirely confident that any true Helderberg is exposed. Beginning at the crystallines east of the shallow valley bounding Pine Hill the succession rises in this order:

Cambric, (fault), Shawangunk grit, Longwood shales (covered for a thickness of 200′; probably faulted at the top of the Longwood shales as limonites are here developed and contain fossils which appear to belong to the lower part of the Helderberg; in this case the Rondout, Cobleskill and Manlius formations are lost by the faulting), Oriskany, Esopus-Schoharie, (Onondaga; not exposed), Bellvale flags, Skunnemunk conglomerate.

All beds on this eastern limb are apparently conformable and the formations of immediate interest have a strike n. 50° e., dip 60° w. In ascending order these beds are:

| | |
|---|---|
| Thin-bedded silicious sandstone with a few thin 1 inch layers of dark shale interbedded; these carry traces of plant stipes, similar to those known in the Helderberg of New York and the equivalent St Alban beds of Gaspé; (Port Ewen beds?) . . . . . . . . . . | 55′ |
| Heavy-bedded yellow silicious residual sandstone carrying fossils in large masses; Oriskany . . . . . . . . . . | 13′ |
| Thin-bedded compact dark blue sandstone . . . . . . . . . . | 14′ |
| Heavy-bedded sandstone lighter in color, gradually changing upward to coarser grain and becoming pebbly. Fossils abundant in upper layers. These beds represent the Esopus and Schoharie grits . . . . . . . . . . | 230′ 5″ |

The higher layers of the grit are better exposed along the railroad 200 yards northeast of the cut.

## NOTES ON THE ORISKANY FAUNA AT HIGHLAND MILLS

### Autodetus beecheri Clarke

Plate 32, figures 1, 2

*See* N. Y. State Mus. Mem. 3. 1900. p. 26, pl. 2, fig. 27-32

This species was described from the Oriskany of Becraft mountain.

### Tentaculites elongatus Hall

Plate 32, figure 8

An Oriskany species, very abundant in these strata and characterized by its simple regular annulations covered with fine concentric lines.

### Coleolus acus Clarke

Plate 32, figures 9-15

Tentaculites ? acus Clarke. N. Y. State Mus. Mem. 3. 1900. p.28, pl. 3, fig. 1-7

This shell is represented by long, slender straight or gently curved cones bearing closely appressed oblique concentric striae on the surface. It occurs also in the Oriskany of Becraft mountain.

### Phacops logani Hall

A few heads and tails only.

### Dalmanites emarginatus Hall

Plate 32, figure 3

This species, based upon a fragment from the Schoharie grit of a pygidium of about the same size and character as that here figured, was subsequently found in more complete preservation in the Grande Grève limestones. [*See* this memoir, pt 1, p.127, pl. 7, fig. 2, 3]

### Pleurotomaria haedillus nov.

Plate 32, figures 32-38

Shell with depressed uniformly sloping whorls and rather shallow sutures, the general form being but slightly turriculate and the total hight less than the basal width. The slit band is conspicuous and elevated on all whorls above the suture. The evenly sloping upper surface of the whorls bears a series of uniform equal ridges or elevated lines concentric to the stoma which on the lower surface of the body whorl are curved or interrupted by one or more low revolving lines. The style of ornament in this species is not greatly unlike that in P. capillaria Conrad of the Hamilton shale fauna, though differences are apparent in the less frequently interrupted and knotted revolving lines, the depressed surface and greater

size. It is one of the rarer species in the fauna, and forms of this type have not been observed in the Oriskany elsewhere.

### **Eotomaria hitchcocki** Clarke

*See* p. 100, pl. 23

This shell, described from the Chapman sandstone of Presque Isle stream, Aroostook co., Me., is represented here by a small form with broadly conical regular shape, sloping whorls, slightly thickened and protuberant at the sutures. It is not common.

### **Tropidocyclus brevilineatus** (Conrad)

Plate 32, figures 4-7

*See* pt 1, p. 220, pl. 17, fig. 7-16

I have identified in the Gaspé sandstone the Bellerophon brevilineatus Conrad as described by Hall from the middle Devonic (Moscow shale) of New York. There is a difference between the Gaspé shell and those illustrated here in the apparent entire absence of the interrupted revolving lines so noticeable in the latter. The shells are very closely allied in all other details of structure and at Highland Mills the species is extremely common.

### **Tropidocyclus rotalinea** (Hall)

Plate 32, figures 23-26

*See* pt 1, p. 229, pl. 17, fig. 3-6

This second species described from the Hamilton shales of New York was also identified by me in the Gaspé sandstone. The Highland Mills specimens are fully comparable with representatives of the species from the two horizons cited. It is a noteworthy fact that these two species which lent their evidence to confirm the middle Devonic character of the Gaspé sandstone fauna should now appear in the Oriskany of New York.

### **Phragmostoma nitela** nov.

Plate 32, figures 27-31

Broadly incurved, body whorl thimble shaped, stoma explanate in full growth but quite usually not greatly expanded. Inner whorls buried in a callus which forms a flat transverse platform on the inner lip. Outer surface of body whorl often with a broad rather indistinct elevated band near the stoma. Surface as usually preserved, with fine elevated and unequally spaced revolving lines crossed only by the irregular growth wrinkles. The slit band with its retrally curved lines is sometimes well defined but often obscured in later growth. This is an unusual type of shell from the early Devonic but a parallel occurrence of this genus is the Phragmostoma diopetes of the Moose River sandstone [*see* p. 70].

### Diaphorostoma pastillus nov.

Plate 32, figures 16-20

A number of specimens have been observed of a uniformly very small rotund shell of this species with a minute spire of two and one half whorls barely rising above the level of the greatly expanded and inflated body whorl. The dimensions do not exceed a hight of 7 mm and width of 6 mm. The surface carries a series of very fine concentric lines cancelated by equally fine sharp revolving lines. By varying preservation or in varying lights sometimes the one and sometimes the other series predominates in expression.

### Loxonema highlandense nov.

Plate 32, figures 21, 22

A slender and graceful shell attaining moderately large size, regularly terete, with no slit band. The whorls are 7 to 9 in number and the sculpture consists of very fine concentric lines with the grouping characterizing Loxonema so much subdued as to give a general smoothness to the surface. The sutures are low and impressed only on the earlier whorls which are more regularly convex; on later whorls the surface near the sutures is flattened in a narrow band.

This species may be directly compared with L. jerseyensis Weller [Pal. Rep't N. J. 1903. 3:335, pl. 43, fig. 8-10] from the Dalmanites dentatus bed at the Nearpass quarry, Port Jervis. That has the same delicately lined surface but not the convex whorls without sutural flattening.

### Pterinea sp.

Shells of uncertain character.

### Nuculites (Ditichia) doto nov.

Plate 33, figures 5-10

Shell small, subtriangular, broadly rounded in front, convex on the lower margin, tapering and slightly contracted behind. Anterior clavicle very strong and reaching two thirds the distance across the valve. A posterior clavicular ridge in front of the posterior muscle scar is always present, broader and lower than the anterior but quite as long.

The hinge consists of a row of denticulations and pits beginning at the posterior muscle where a few large pits are divided by alternating small ones, thenceforward with more uniform size and angled shape, they become thin, vertical, longer and more crowded till reaching the broader surface beneath the beak they show a reversed angulation and end abruptly.

### Nuculites fraxinus nov.

Plate 33, figures 1-4

This shell is small and slender, distinguished from N. doto by its rapidly tapering and extended form, complete absence of the posterior clavicle and much more finely toothed hinge. Body of shell not constricted; surface with fine concentric lines as usual in this group of shells.

### Mytilarca sp.

Shells of this genus occur with some frequency but their specific values are still obscure.

### Carydium gregarium Beushausen

Plate 33, figures 11-14

*See* p. 33

On a previous page I have noted the presence of this Coblentzian genus and species in the Dalhousie beds. It has been interesting to find this species in the Pine Hill deposits with its peculiar hinge structures as described by Beushausen sharply defined; a small anterior subumbonal tooth and a long curving postumbonal denticulate ridge passing outwardly into a deep socket (in the left valve) and beyond this a narrow ligament area.

### Goniophora cercurus nov.

Plate 33, figures 18-22

This is a shell of average size in which the exterior is covered with sharply elevated crowded, more or less confluent concentric lines, the umbonal ridge, angular in early growth, becoming obscure toward the margin. Internal casts lose the ridge and present the aspect of Modiomorpha with simple linear ligament area and hinge, well defined anterior and posterior muscle scars and a visceral surface quite invariably marked by strong broken or continuous radial lines extending to the position of the pallial scar.

### Macrodus ? desuetus nov.

Plate 33, figures 15-17

A species of rather large size for the genus, with elongate quadrangular shape, broad low median umbonal cincture, broadly elevated concentric growth bands, carries the hinge structure of Macrodus.

### Lunulicardium ? sp.

Plate 33, figure 23

In the Gaspé sandstone occurs a species which has been described as Lunulicardium ? convexum [*see* this memoir, pt 1, p.234, pl. 23,

fig. 12] and a shell of very similar character has been obtained in the fauna under consideration. It is a left valve of considerable size, quite strongly and evenly plicated radially with a prominent anterior (byssal) ridge. While the true generic character of this shell and its ally from the Gaspé sandstone is entirely a matter for future determination, the concurrence of these forms in the formations in question is interesting.

### Leptocoelia flabellites (Conrad)

Plate 34, figures 17–20

*See* pt 1, p. 174; pt 2, p. 81

Extraordinarily abundant, of normal or medium size; that is, not attaining the large dimensions reached by the species in the Grande Grève limestones; often prevailingly small in places but generally holding the characters of the shell in its cosmopolitan distribution.

### Megalanteris diobolaris nov.

Plate 34, figures 1–5

A persistently small lenticular shell with a subcircular outline slightly extended on the front margin; in size less than that prevailing in Beachia suessana but similar in outline, though generally more rounded. In Megalanteris ovalis and Beachia suessana Hall the lateral margins are notably introverted; here, however, the introversion is very slight, confined to the shoulders of the valves and noticeable only on very well preserved specimens, particularly internal casts. In interior structure the species is distinctively a Megalanteris. It has a very prominent club-shaped thickened cardinal process more or less deeply grooved at its summit and in extremely thickened specimens deeply constricted by a groove which sets off the cardinal process from its base. The umbonal region of the dorsal valve is thickened and covered with vascular pits and grooves.

The muscle scars are prominent in both valves as in M. ovalis but not so sharply defined on their anterior edges. Most noticeable, however, as a differential of the species is the unusual development of the cardinal area of the ventral valve which under ordinary preservation stands out prominently above the dorsal valve and is much more pronounced in size than in any other known species. Average specimens of this species, and they are quite uniform in size, have a length across the shoulders and an axial length of about 25 mm.

I have felt somewhat constrained to identify this shell with Megalanteris condoni McChesney [Rensselaeria condoni McChesney, Palaeozoic Fossils. 1861. p. 85. Chicago Acad. Sci. Trans. 1867. 1:36, pl. 7, fig. 2; Meek & Worthen, Geol. & Palaeontol. Ill. 1868. 3:401, pl. 8, fig. 4a, b; Megalanteris condoni Hall & Clarke, Pale-

ontol. N. Y. 1894. v. 8, pt 2, p. 280] from the cherts of Oriskany age on Clear Creek, Union county, Illinois, but the illustrations of that shell are meager and the specimens I have been able to secure for exact comparison do not seem to justify the assumption of identity.

### Spirifer aroostookensis Clarke

Plate 34, figures 6–16

*See* p. 110

This species described from a single dorsal valve in the Chapman sandstone of Aroostook county, Maine [N. Y. State Mus. Bul. 107. p. 258. 1907, and *ante* p. 119, pl. 20, fig. 5; pl. 30, fig. 5, 9], is characterized by its flat riblets, slightly depressed or even grooved on top and all the surface covered by closely concentric papillated lines. These riblets are 10–14 in number on each side of the median fold, and the spaces or grooves between them are very narrow and sharp with vertical sides. The only well known species with which one might bring this shell into close comparison is Sp. concinnus Hall of the Helderbergian and Dalhousie fauna. The differences however are clear: The riblets of Sp. concinnus though low have not the broadly flattened, depressed or even slightly grooved surfaces of S. aroostookensis, nor the narrow vertical grooves between; the cardinal area is higher and the beak more prominent and overarched; as a rule the outline of this shell is less extended on the hinge. The abundant and only observed spirifer in the fauna at Highland Mills has all the distinguishing characters of S. aroostookensis, occurring usually in the form of casts, interior and exterior. The cast of the exterior presents with striking effect the peculiarities of the flat riblets and the threadlike ridges representing the dividing furrows. Often the ribs, on account of the more extended lateral slopes will rise to 16–17 in number. The papillose surface is shown on well preserved external casts only; this is unlike that in S. concinnus where one observes it usually only on young shells, in maturity the surface presenting a series of fine concentric lines. On the interior of these shells there is considerable variation in the character of the muscle scars, those of the ventral valve in old shells being deep set and somewhat expanded, often with ramifying markings, but in younger individuals having less size and prominence. No distinctive value can well be laid on such differences.

Of all the specimens observed the mature ones reach about the proportions of the original of S. aroostookensis, seldom attaining the size or outline of the mature and prevailing S. concinnus in the Lower Devonic limestones of New York and Dalhousie. Were it desirable to enforce the distinctive traits of this species by contrast with its associates in time it may be remarked that S. cyclopterus of the Helderberg fauna is a fimbriate shell with rounded and sparse ribs, broad and sloping

furrows; S. murchisoni is sparse and coarse ribbed with conspicuous fold and sinus, but also fimbriate; S. cymindis is smaller, having the proportions but not the size of S. concinnus.

### Cyrtina rostrata Hall

*See* pt 1, p. 183

These shells vary very much as do those of the Beçraft Mountain Oriskany from small erect trihedral form (C. varia Clarke) to elevated shells with curved cardinal area, the riblets being from 4 to 8 on each side of median fold or sinus. Within these limits the shell keeps free of implication with large and rugose forms which served as the type of C. rostrata Hall.

### Meristella sp. indet.

### Leptaena rhomboidalis Wilckens

*See* pt 1, p. 183; pt 2, p. 45, 122

Not common.

### Leptostrophia becki Hall

*See* pt 1, p. 111; pt 2, p. 46

The species occurs occasionally.

### Chonetes (Eodevonaria) cf. arcuata Hall

Plate 34, figures 21–31

*See* Hall. Palaeontology of New York. 4:119, pl. 20, fig. 7

Professor Hall described from the Onondaga limestone a large Chonetes, C. arcuata, having a highly convex ventral valve, specially arched in the umbonal region, a surface covered with fine striae and with the hinge denticulations which characterize Eodevonaria fully developed. There is a closely allied shell in this fauna notable for its conspicuous size and its finely striated exterior surface, but it is a flat, relatively elongate shell, not presenting the arched surface nor the median ventral depression which characterize C. arcuata. The legitimate ancestor of that species it may well be but its differences are recognizable and are expressed in the accompanying figures. Among other species of Eodevonaria, Chonetes dilatata Roemer (Coblentzian) possesses its outline and flatness and is a close ally.

### Chonetes highlandensis nov.

Plate 34, figures 32–41

There is a group of small highly convex coarsely ribbed Chonetes which are as characteristic of early Devonic age as those which constitute the sub-

genus Eodevonaria. In this little association are Chonetes billingsi of the Grande Grève limestone and Gaspé sandstone, C. nectus, Moose River sandstone, C. laticosta Hall, C. mucronatus Hall and the species under consideration. Chonetes laticosta Hall was described from the Onondaga limestone and C. mucronatus from the Marcellus shale. Hall united both terms under the latter in his redescription [Palaeontology of N. Y. 4 : 126] though still recognizing that the earlier examples are more convex and more coarsely and sharply plicated than the later. It seems quite likely that the apparent difference to typical C. laticosta and C. mucronatus is permanent and always recognizable. C. highlandensis, the species before us, is another shell of this small convex coarse ribbed type quite distinctively characterized in the following respects: The ventral valve is almost gibbous with a decided median elevation and the surface carries 12–14 riblets which are coarse and well defined in early growth but become obscure and obsolete on the anterior slopes of the valve. This peculiar obsolescence of the ribs lends a special distinguishing feature to the shell, to which may be added usual indications of interrupted periodic growth. The casts of the exterior do not indicate the presence of the fine concentric lines present in C. billingsi, C. laticosta and C. mucronatus. So marked is the obsolescence of the riblets in late growth that it is not clear whether they increase by normal bifurcation on the valve except at some abrupt growth line. On the dorsal valve, however, where the ribs seem to be fewer, bifurcation is common. The hinge is cornute and not denticulate. On the interior of the ventral valve is a short but deep median septum at either side of which are broadly flabellate muscle scars. On the dorsal the cardinal process is erect and divided; the interior surface bears granulated riblets, of which a median pair separated by a single rib is most prominent, the aspect in this respect of the interior being like that in C. billingsi. With other preservation the elevated muscle scars are apparent. The average adult shell of this species has a width of 7 mm and a length of 6 mm. It is very abundant.

### **Dalmanella planoconvexa** Hall

Quite characteristic examples of this Helderbergian species are common.

### **Dalmanella perelegans** Hall?

*See* pt 1, p. 61

Probably the same as the Helderbergian species.

There are in this fauna, so far as known, certain features already referred to as present in that element of the Gaspé sandstone which have seemed to the writer to distinctively mark a Middle Devonic (Hamilton) age. In the presentation of the Gaspé sandstone fauna in part 1 of this

work, it was shown that a very large numerical percentage of its species are of this later Devonic age, even though accompanied by survivors of the typical Lower Devonic fauna of the Grande Grève limestone. In this larger percentage of species, regarded as confirming the Hamilton age of the Gaspé sandstones, were listed three species, Tropidocyclus brevilineatus, T. rotalinea and Lunulicardium ? convexum — two described from the Hamilton fauna of New York and the third indicative of later than Oriskany age — which it is surprising and interesting to find present in this Oriskany fauna of Pine Hill. There can here arise no question of the early Devonic age of the Pine Hill congeries but the presence of the species mentioned requires us to qualify the diagnostic value previously ascribed to them as exclusively Middle Devonic species and to accept them as equally of Lower Devonic value. So far as this construction affects the interpretation of the Gaspé sandstone fauna it might seem to subtract these species from the census of the Hamilton element therein represented. Such a construction, however, would probably not be an entirely correct expression, for even though members of a Lower Devonic fauna in eastern New York, they are also members of a Middle Devonic fauna in central and western New York, and their associates there in this later stage are, in number and leading importance, their associates in the Gaspé sandstone. It would not alter the valuation of the Gaspé sandstone fauna to divert these species from the Middle to the Lower Devonic contingent, because of the continued preponderance of the former; but as the species are of perduring age, it would still be my view that their presence in Gaspé confirms the indicated Middle Devonic age of that fauna.

## TABLE OF THE ORISKANY FAUNA OF NEW YORK-NEW JERSEY REGION

Capitals before species names indicate the responsible authorities for the determinations: C=Clarke, Ch=Chadwick, H=Hall, S=Shimer, V=van Ingen, W=Weller

### Fishes

*V*............ Machaeracanthus sulcatus *Newberry*

### Annelids

*CV*.......... Spirorbis assimilis *Clarke*
*C*............ Autodetus beecheri *Clarke*
*C*............ Annelid teeth
*C*............ Cornulites cingulatus *Hal*
*CSVW*....... Tentaculites elongatus *Hall*
*SW*.......... T. acula *Hall*
*C*............ Coleolus acus *Clarke*
*V*............ Spirophyton caudagalli

### Crustacea

*CV*. . . . . . . . . Dalmanites (Synphoria) stemmatus *Clarke*
*C*. . . . . . . . . . . D. (S.) stemmatus *var.* convergens *Clarke*
*SW*. . . . . . . . . D. dentatus *Barrett*
*V*. . . . . . . . . . . D. pleuroptyx *Green*
*C*. . . . . . . . . . . D. phacoptyx *Hall & Clarke*
*C*. . . . . . . . . . . D. bisignatus *Clarke*
*C*. . . . . . . . . . . D. emarginatus *Hall*
*W*. . . . . . . . . . D. *sp.*
*C*. . . . . . . . . . . Phacops correlator *Clarke*
*CV*. . . . . . . . . P. logani *Hall*
*SW*. . . . . . . . . P. *sp.*
*SW*. . . . . . . . . Homalonotus vanuxemi *Hall*
*V*. . . . . . . . . . . H. major *Whitfield*
*C*. . . . . . . . . . . H. *sp.?*
*CV*. . . . . . . . . Proetus conradi *Hall*
*C*. . . . . . . . . . . Cordania becraftensis *Clarke*
*C*. . . . . . . . . . . C. hudsonica *Clarke*
*C*. . . . . . . . . . . Cyphaspis minuscula *Hall*
*C*. . . . . . . . . . . Ceratocephala tuberculata (*Conrad*)
*C*. . . . . . . . . . . Lichas *cf.* pustulosus *Hall*
*CW*. . . . . . . . . Beyrichia *sp.*
*V*. . . . . . . . . . . Isochilina *sp.*
*W*. . . . . . . . . . Leperditia *sp.*
*C*. . . . . . . . . . . Plumulites

### Cephalopods

*VW*. . . . . . . . . Orthoceras

### Pteropods

*W*. . . . . . . . . . Hyolithus centennialis *Barrett*
*S*. . . . . . . . . . . Conularia pyramidata jervisensis *Shimer*
*H*. . . . . . . . . . C. lata *Hall*
*C*. . . . . . . . . . . C. *sp.*

### Gastropods

*C*. . . . . . . . . . . Tropidocyclus brevilineatus (*Conrad*)
*C*. . . . . . . . . . . T. rotalinea (*Hall*)
*C*. . . . . . . . . . . Phragmostoma nitela *Clarke*
*C*. . . . . . . . . . . Bellerophon *sp.*

*HCV* ..... Cyrtolites expansus *Hall*
*C*.......... Pleurotomaria haedillus *Clarke*
*C*.......... Eotomaria hitchcocki *Clarke*
*CSVW*...... Diaphorostoma desmatum *Clarke*
*HCSVW*.... D. ventricosum (*Conrad*)
*SW* ....... D. nearpassi *Weller*
*C*.......... D. pastillus *Clarke*
*HCV*....... Strophostylus expansus *Conrad*
*HCVW*..... Orthonychia *cf.* tortuosa *Hall*
*HCV*....... Platyceras nodosum *Conrad*
*H*......... P. subnodosum *Hall*
*CV*........ P. *cf.* gebhardi *Hall*
*SV*........ P. lamellosum *Hall*
*SV*........ P. reflexum *Hall*
*SV*........ P. platystoma *Hall*
*HS*........ P. ventricosum *Hall*
*SW*........ Loxonema jerseyense *Weller*
*C*.......... L. highlandense *Clarke*

**Pelecypods**

*CV*........ Pterinea
*C*.......... Pterinopecten subequilatera (*Hall*)
*CV*........ P. proteus *Clarke*
*C*.......... P. signatus *Clarke*
*C*.......... P. pumilus *Clarke*
*HV*........ Aviculopecten recticosta (*Hall*)
*H*......... A. gebhardi *Hall*
*C*.......... A. *sp.*
*C*.......... Lyriopecten *sp.*
*C*.......... Actinopteria communis (*Hall*)
*CW*........ A. insignis *Clarke*
*SW*........ A. textilis (*Hall*)
*HSVW*..... A. textilis arenaria (*Hall*)
*C*.......... Goniophora cercurus *Clarke*
*S*.......... Grammysia
*C*.......... Macrodus? desuetus *Clarke*
*CV*........ Megambonia crenistriata *Clarke*
*H*......... M. lamellosa *Hall*

*W*. . . . . . . Megambonia parva *Weller*
*HW*. . . . . . . M. bellistriata *Hall*
*S*. . . . . . . . . . . Nuculites barretti *Shimer*
*C*. . . . . . . . . . . N. fraxinus *Clarke*
*C*. . . . . . . . . . . N. (Ditichia) doto *Clarke*
*CSV*. . . . . . . . Cypricardinia lamellosa *Hall*
*C*. . . . . . . . . . . Carydium gregarium *Beushausen*
*C*. . . . . . . . . . . Conocardium inceptum *Hall?*
*C*. . . . . . . . . . . Lunulicardium?

**Brachiopods**

*HCSV*. . . . . . Rensselaeria ovoides (*Eaton*)
*SW*. . . . . . . . . R. subglobosa *Weller*
*S*. . . . . . . . . . . R. aequiradiata *Hall*
*HCV*. . . . . . . Megalanteris ovalis *Hall*
*C*. . . . . . . . . . . M. diobolaris *Clarke*
*HSVW*. . . . . Beachia suessana *Hall*
*CV*. . . . . . . . . Cryptonella fausta *Clarke*
*CV*. . . . . . . . . Oriskania sinuata *Clarke*
*HCV*. . . . . . . O. navicella *Hall & Clarke*
*HCVW*. . . . . Camarotoechia barrandii *Hall*
*Ch*. . . . . . . . . . C. acutiplicata *Hall*
*HCV*. . . . . . . C. fitchana *Hall*
*HCV*. . . . . . . C. oblata *Hall*
*HV*. . . . . . . . C. pliopleura *Hall*
*H*. . . . . . . . . . C. principalis *Hall*
*H*. . . . . . . . . . C. septata *Hall*
*HV*. . . . . . . . C. multistriata *Hall*
*H*. . . . . . . . . . C. speciosa *Hall*
*W*. . . . . . . . . . C. biplicata *Hall*
*H*. . . . . . . . . . C. ramsayi *Hall*
*W*. . . . . . . . . . C. bialveata *Hall*
*C*. . . . . . . . . . . C. dryope *Billings*
*ChS*. . . . . . . . Uncinulus vellicatus *Hall*
*Ch*. . . . . . . . . . U. pyramidatus *Hall*
*ChV*. . . . . . . . U. campbellanus *Hall*
*Ch*. . . . . . . . . . U. nobilis *Hall*
*Ch*. . . . . . . . . . U. ventricosus *Hall*

| | |
|---|---|
| *ChV* | Uncinulus mutabilis *Hall* |
| *Ch*.......... | U. abruptus *Hall* |
| *SW*.......... | Stenocisma formosum *Conrad* |
| *CV*.......... | Eatonia medialis (*Vanuxem*) |
| *HCVW*..... | E. peculiaris (*Conrad*) |
| *V*.......... | E. singularis (*Vanuxem*) |
| *HV*........ | E. whitfieldi *Hall* |
| *H*.......... | E. sinuata *Hall* |
| *CV*......... | Anastrophia verneuili *Hall?* |
| *CV*......... | Coelospira concava *Hall* |
| *CSVW*...... | C. dichotoma *Hall* |
| *V*.......... | C. acutiplicata *Hall* |
| *HCVSW*.... | Leptocoelia flabellites (*Conrad*) |
| *V*.......... | Trematospira costata *Hall* |
| *CV*......... | T. multistriata *Hall* |
| *Ch*.......... | T. perforata *Hall* |
| *V*.......... | T. *sp. n.* |
| *V*.......... | Rhynchospira formosa *Hall* |
| *V*.......... | Parazyga deweyi *Hall* |
| *HCSV*...... | Meristella lata *Hall* |
| *CV*......... | M. vascularia *Clarke* |
| *Ch*.......... | M. princeps *Hall* |
| *CV*......... | M. lentiformis *Clarke* |
| *Ch*.......... | M. laevis *Hall* |
| *W*.......... | M. princeps *Hall* |
| *Ch*.......... | M. bella *Hall* |
| *SV*......... | Nucleospira elegans *Hall* |
| *V*.......... | N. ventricosa *Hall* |
| *Ch*.......... | Atrypa reticularis *Linné* |
| *HCSVW*.... | Spirifer arenosus (*Conrad*) |
| *SV*......... | S. cyclopterus *Hall* |
| *CSVW*...... | S. murchisoni *Castelnau* |
| *W*.......... | S. plicatus (*Weller*) |
| *V*.......... | S. tribulis *Hall* |
| *W*.......... | S. nearpassi *Weller* |
| *CV*......... | S. saffordi *Hall* |
| *S*........... | S. modestus *Hall* |

| | |
|---|---|
| *C*.......... | Spirifer aroostookensis *Clarke* |
| *HCV*....... | Metaplasia pyxidata *Hall* |
| *V*.......... | Ambocoelia *sp. n.* |
| *CVW*....... | Chonetes (Eodevonaria) hudsonicus *Clarke* |
| *HCVW*..... | C. rostrata *Hall* |
| *C*.......... | C. highlandensis *Clarke* |
| *C*.......... | C. (Eodevonaria) arcuata *Hall* |
| *HCSV*...... | Chonostrophia complanata *Hall* |
| *SW*......... | C. jervisensis *Schuchert* |
| *HSVW*..... | Anoplia nucleata *Hall* |
| *CV*......... | Orthothetes (Schuchertella) becraftensis *Clarke* |
| *V*.......... | O. (S.) woolworthanus *Hall* |
| *HCVW*..... | Hipparionyx proximus *Vanuxem* |
| *HCV*....... | Stropheodonta lincklaeni *Hall* |
| *HV*........ | S. magniventer *Hall* |
| *H*.......... | S. vascularia *Hall* |
| *CSV*........ | Leptostrophia oriskania *Clarke* |
| *S*.......... | L. becki *Hall* |
| *HCVW*..... | L. magnifica *Hall* |
| *Ch*.......... | L. planulata *Hall?* |
| *CV*......... | Brachyprion schuchertanum *Clarke* |
| *CV*......... | B. major *Clarke* |
| *CSVW*...... | Leptaena rhomboidalis *Wilckens* |
| *HVW*....... | L. ventricosa *Hall* |
| *Ch*.......... | Leptaenisca concava (*Hall*) |
| *S*.......... | Strophonella conradi *Hall* |
| *Ch*.......... | S. leavenworthana *Hall* |
| *Ch*.......... | S. punctulifera (*Conrad*) |
| *CVW*....... | Dalmanella perelegans *Hall* |
| *CV*......... | D. planoconvexa *Hall* |
| *Ch*.......... | D. quadrans *Hall* |
| *SW*......... | D. subcarinata *Hall* |
| *Ch*.......... | D. concinna *Hall* |
| *CSVW*...... | Rhipidomella oblata *Hall* |
| *HVW*...... | R. musculosa *Hall* |
| *V*.......... | R. emarginata *Hall* |
| *V*.......... | R. discus *Hall* |

| | |
|---|---|
| *S* | Schizophoria multistriata *Hall* |
| *C* | Crania pulchella *Hall & Clarke* |
| *CVW* | Pholidops terminalis *Hall* |
| *VW* | P. ovatus *Hall* |
| *W* | Schizocrania? superincreta *Barrett* |
| *HSW* | Orbiculoidea ampla *Hall* |
| *S* | O. jervisensis *Barrett* |
| *W* | Lingula *sp.* |

**Bryozoa**

| | |
|---|---|
| *C* | Rhombipora rhombifera *Hall* |
| *C* | Stictopora *sp.* |
| *C* | Unitrypa lata *Hall* |
| *C* | U. acclivis *Hall* |
| *C* | Monotrypella arbusculus *Hall & Simpson* |
| *Ch* | M. tabulata *Hall* |
| *S* | M.? abrupta *Hall* |
| *C* | Lichenalia *cf.* crassa *Hall* |
| *Ch* | L. torta *Hall* |
| *C* | Polypora separata *Hall?* |
| *C* | P. *sp.* |
| *C* | Polyporella *cf.* compressa *Hall* |
| *CV* | Fenestella biseriata *Hall?* |
| *C* | Hemitrypa columellata *Hall* |
| *C* | Isotrypa *sp.* |
| *C* | Reteporina *sp.* |
| *V* | Chaetetes sphaericus |

**Crinoids**

| | |
|---|---|
| *C* | Edriocrinus becraftensis *Clarke* |
| *HVW* | E. sacculus *Hall* |

**Corals**

| | |
|---|---|
| *Ch* | Enterolasma strictum (*Hall*) |
| *Ch* | Duncanella rudis *Girty* |
| *Ch* | Favosites helderbergiae *Hall* |
| *Ch* | Zaphrentis roemeri *Hall* |
| *C* | Ptychonema helderbergiae *Hall?* |
| *CV* | Cladopora smicra *Clarke* |
| *C* | C. *cf.* styphelia *Clarke* |
| *V* | Pleurodictyum lenticulare (*Hall*) |

*C*. . . . . . . . . . . Aulopora *cf.* schoharie *Hall*
*V*. . . . . . . . . . Aulopora
*C*. . . . . . . . . . . Vermipora streptocoelia *Clarke*
*CSW*. . . . . . . V. serpuloides *Hall*
*C*. . . . . . . . . . . Hederella magna *Hall & Simpson*
*C*. . . . . . . . . . . H. arachnoidea *Clarke*
*C*. . . . . . . . . . . H. ramea *Clarke*
*C*. . . . . . . . . . . H. graciliora *Clarke*
*W*. . . . . . . . . . Trachypora oriskania *Weller*

Graptolites

*C*. . . . . . . . . . . Dictyonema *cf.* splendens *Billings*

Sponges

*V*. . . . . . . . . . Hindia fibrosa (*Roemer*)

## GENERAL CONCLUSIONS

From the foregoing considerations based chiefly on the analyses of the faunas we may justly draw some reasonable inferences as to the connections of the northeast basins of the early Devonic with those to the south and west. Such inferences can be stated only as probable for there still remains in eastern Quebec and northern Maine an extensive area whose structure is insufficiently known to afford entire security in indicating the boundaries of these passages. Some of these inferences have already been set forth in their proper place but to restate them briefly we conclude:

1 There was a definite and clear passage from Gaspé into New York and the more southern Appalachians during the period of the Helderbergian, where a well defined element of the Helderbergian flourished in the St Alban beds at the base of the Gaspé limestone series.

2 A similar open way existed at approximately or actually the same time, connecting the Dalhousie beds of northern New Brunswick with the Helderbergian of New York.

3 That these two passages seem to have converged and united into one toward the west and south, for while each carries a clear predominance of Helderberg species, the two have comparatively little in common, the

fauna of one representing essentially one congeries, that of the other a different congeries of species which are apparently commingled in New York.

4 That in the later stage represented by the profuse fauna of the Grande Grève limestones the northern passage broadened while the Dalhousie passage became extinct; and that passage remained open till much later in the Devonic than Helderbergian time. This fact is evinced by the somewhat lessened though by no means obliterated presence of Helderberg species, by the full development of characteristic Oriskany species in the purest limestone medium and the existence of certain types of still later (Onondaga) age in minor or prenuncial phases of development. The opinion has been expressed that during this period of the Grande Grève limestones the Gaspé basin was a place of rapid fructification and departure of the fauna toward the southwest.[1]

5 In northern Maine that part of the Devonic represented by the arenaceous sediments of Aroostook county must have pertained to a distinct geographic passageway and have been more or less obstructed southward during the period of the Oriskany. It is quite possible that the same channel was open in its southwest extent during Helderbergian time as indicated by the fauna of the Square Lake limestone, though the differences therein from the New York Helderbergian would still indicate that the way was then not entirely clear open and carried basins of special development.

6 The development of the early Devonic fauna in Piscataquis and Somerset counties, Me., though this series of rocks is apparently not

[1] Lest some misconception arise as to the real value of the Grande Grève fauna it may be well to rehearse the fact that the predominant element is the Oriskany and that such suggestions of the Onondaga fauna as are present are ontologically and chronologically immature, so that the time or correlation value of the fauna can not be estimated on the basis of these species. The stratigraphic division of the Grande Grève limestone begins at its base with beds carrying a commanding Oriskany expression but the species of Rensselaeria, Hipparionyx, large Leptostrophia and Camarotoechia which these basal beds contain are continued through the higher strata with such uniformity that a division of the fauna on the basis of stratigraphy is not to be entertained.

widely separated in continuity or direction from the Aroostook county faunas, is unlike the latter, is more decided in its representation of New York Oriskany types, and yet has many special features in common with those of Aroostook county. At all events this area indicates no entire severance from the former and also declares for a wide open passage southward.

7 As far southward as northern Maine the calcareous character of the Oriskany facies is already lost in spite of its predominance further north and east, yet in this regard it can not be said to conform more fully with the New York development for that is on the whole more calcareous than arenaceous, save as the limestones of the New York Oriskany carry large percentages of silica and weather freely to a silicious residuum.

8 The more southerly of these passages show in their fauna traits which the northerly do not, namely, a striking array of affiliations with the Coblentzian fauna of the Transatlantic. It would be difficult to assign any other reason for this than that the northerly passages ended in the open sea or that that part of the channel in which they flourished failed entirely of continuity with the eastern continent while more southerly parts left freer connection with the east at contemporaneous periods. These affiliations with European faunas have been specifically indicated in the text and imply a well defined westward invasion along these eastern channels in this early period of the Devonic.

9 There was still another quite well defined channel of this time which has not here been specially considered, namely that represented by the beds of Perry, Me.-St John, New Brunswick-Annapolis, Nova Scotia. This southernmost Devonic channel is little known at present. Its fossils have been studied by Dawson and Matthew for the New Brunswick and Nova Scotia occurrences and by Williams for the manifestations in Washington county, Me. We have had extensive collections from the last but the preservation is not favorable and indicates that exact information in regard thereto is still to be desired.

10 All these various channels of the early Devonic in the northeast

converged southwestward. It is probable, however, that they passed on southward, after the union of some of them, by different thoroughfares. We here come face to face with certain hypotheses with substantial evidence behind them and they may be stated in terms which will permit of their modification after more detailed knowledge is acquired.

11 The probable trunk troughs entering the southern portions of the geosyncline may be indicated thus:

*a* **The Connecticut Valley trough.** The valley of the Connecticut is ancient, probably not differing in origin from the parallel valleys of Lake Champlain and the Hudson as a graben valley or at least outlined by zones of master faulting. Between the crystalline boundaries of this trough at Lake Memphremagog and southward are evidences showing that it was open earlier than the Devonic, as witness the limestones at Littleton, N. H. with species of Dalmanites (D. lunatus Lambert) apparently of very late Siluric age.

At Lake Memphremagog are grits carrying Taonurus which have been identified by Dr Ami with the Esopus grit but the argillites both above and below these grits contain fossils; a Dalmanites similar to the D. coxius of the Grande Grève limestone, an Orthoceras of distinctive character, with traces of other fossils. While the Taonurus alone can not be taken as a safe guide for identification with the Esopus horizon of New York yet the accessory evidence is confirmatory of an age for these deposits essentially equivalent to the Oriskany.

Still farther south at the north line of Massachusetts is the well known occurrence of partly metamorphosed Paleozoic fossils at Bernardston, contained in a limestone and an overlying quartzite. These fossils, of which I have had opportunity to examine large series, are invariably distorted in the quartzite where they most abound so that any resemblance they may assume is too often a resemblance by distortion and a determination thereof carries a large element of fiction and imagination. I believe, however, that the conclusions reached long since by Whitfield in regard to the age of these rocks, that the limestones with large crinoid columns are Helder-

bergian and the quartzites above with distorted brachiopods are Oriskany, is as close an approximation to the truth as the known facts permit.

We must now again call attention to the attitude of the Helderbergian and Oriskanian rocks in the Helderberg mountains of New York, reiterating the statement made on the first page of this memoir. They stand in an escarpment facing the west, north and east overlain by the great thickness of later Devonic and Devono-Carbonic constituting the Catskill mountains. Their faces are terraced faces of erosion. Their former extent was in the directions which they face. Beyond any doubt these rocks extended eastward of the Hudson and into western Massachusetts. In the view of Prof. B. K. Emerson, the ultimate authority on the crystallines of Massachusetts, there was here in western Massachusetts an undoubted Precambric north-south ridge whose position above water is indicated by the presence of a Cambric quartzite fringing the greater portion of the outcrops. This may have been repeatedly depressed and elevated and the adjoining Siluric masses brought to day but there are no antagonistic considerations for assuming that it was all transgressed during the Devonic and these Devonic deposits removed entirely by erosion. Toward the north of this region near the north line of the state is a break in the Precambric ridge which is of considerable width, extending into Vermont and this may have well served as a passage for Devonic sediment from New York into the Connecticut trough. East of the Connecticut river there is only a limited area of Precambric near the Rhode Island line, extending south into Connecticut along Long Island sound. This is everywhere margined by a quartzite interpreted as Cambric, and this with the fossil-bearing Cambric localities at Nahant, North Attlebury and Braintree was raised into land and so continued through Siluric and Devonic time, no rocks of this age being determinable. Professor Emerson regards all these rocks above the Cambric as Carbonic coextensive with the Worcester and Mansfield coals.

These conclusions give evidence enough of an old land barrier bounding a trough of Devonic waters in which the metamorphosed beds of Bernardston at least were deposited. The rest may have been removed by

erosion, but in eastern New York between the Hudson and the Massachusetts line and in the direction of the Devonic rocks of Bernardston lies an extensive sheet of coarse clastic material known as the Rensselaer grit which at this point requires brief attention.

*Rensselaer grit.* Rensselaer and Columbia counties, New York, lying east of the Hudson river and in the general direction of continuity between the Helderberg-Catskill escarpment and the Bernardston Devonic outcrops of the Connecticut valley, are extensively mantled by heavy arenaceous deposits lying unconformably on the unfolded Cambric and Lower Siluric strata beneath. The character and distribution of this rock was clearly outlined by Lieutenant Mather in his report on the First geological district (1843) and it was regarded by him as equivalent in age with the Shawangunk grit of Ulster and Orange counties on the west of the river.

The early geologists held the Shawangunk grit to be an eastern representation of the Oneida grit of central New York and this conception has been quite generally promulgated. Mr T. Nelson Dale has been one of the latest investigators of this region and has acquired an intimate knowledge of the stratigraphic relations of this terrane to the unconformable rocks beneath and we owe to him the conclusion that the upfolding of the lower and upper terranes pertains to different dates, the former to the Taconic and the latter to the Postdevonic or Carbonic movement which also produced the more southerly synclines now represented by Becraft mountain, Columbia county. Mr Dale has correlated the Rensselaer grit with the entire Oneida-Medina sedimentation of eastern New York. In recent investigations carried on by C. A. Hartnagel [*see* Mus. Bul. 107. 1907. p. 51] it is shown with approximate conclusiveness that in the typical sections of central New York the Oneida conglomerate is not a formational unit but actually lies within the Medina sandstones; that further, the Shawangunk grit, on stratigraphic evidence alone, is of an age much later than the Medina formation and being overlain by rocks of Postsalina age is presumably the eastern representation of Salina deposition. The confirmation of this conclusion as to the value of the Shawangunk grit, was afforded by

the discovery of an extensive eurypterid fauna in the interbedded shales of the Shawangunk grit, as described by the writer [*see op. cit.* p. 294]. Mr Hartnagel has indicated the improbability of this Siluric age of the Rensselaer grit or its equivalence to the Oneida-Medina sediments with the following arguments: (1) the extensive gap by nondeposition between the eastern terminus of the Oneida conglomerate, in Herkimer county, and the Rensselaer grit plateau, (2) the long time interval which must be postulated to account for the Taconic folding and the erosion that preceded the deposition of the grit, (3) the gradual transgression northward of arenaceous sediments over the eroded folds, the Shawangunk grits being a more southerly and hence earlier representative of such transgression.

The region of the Rensselaer grit has recently been carefully searched for fossils but though this evidence still fails and its absence can not be explained by secondary changes in the rocks, the stratigraphic considerations indicate the propriety of assigning a distinctly later than Medina age to this formation.

Near the edge of this plateau no beds of later than Trenton age have been observed and there are apparently no outliers to bridge the gap between the late Siluric and early Devonic outliers of Becraft mountain, Mt Bob and the southernmost outliers of Rensselaer grit in the town of Austerlitz, Columbia county. This last named outlier is of especial interest as it lies but 20 miles northeast of Becraft mountain and is a considerable distance south of the main Rensselaer grit plateau. For these reasons it has been closely studied but found to be in no way lithologically different from the grit of Rensselaer county at the north, containing the same alternations of grit with red and greenish slates.

From the presence of only the closing stage of the Upper Siluric at Becraft mountain and in the Helderberg near Albany, (Countryman hill) — the two places where the deposits of the Siluro-Devonic basin of New York approach nearest to the Rensselaer grit plateau — it may be properly inferred that the Upper Siluric sea of New York did not extend into the present area of the Rensselaer grit plateau at any time except possibly in

the latest (Manlius) stage of that period. In regard to the latter, the problem is the same as in regard to the Helderberg limestones in general which are exposed at Becraft mountain and of which the Rensselaer grit might be conceived as representing the littoral facies. In favor of this view it may be said that both formations rest on the same basis (Cambric and Lower Siluric slate) and that on account of the rising of the Taconic mountains in early Siluric time, there may have existed a littoral facies of the Helderberg rocks to the east. But this view is strongly opposed by the fact that the Helderberg rocks do not show any indications of approach to a littoral region at Becraft mountain, but retain the same lithologic characters over a vast area. There would hence have to be assumed an extremely abrupt and improbable change in facies in the short distance of 20 miles from Becraft mountain to the outlier at Austerlitz. A somewhat different case is presented by the Oriskany sandstone, Esopus grit and Schoharie grit which in some places, as at Whiteport and Kingston, contain conglomerate beds. It is altogether probable that the material of these conglomerates was derived from the south and the Oriskany sandstone is too thin a layer (30 feet) at Becraft mountain, to be correlated with the thick mass of the Rensselaer grit (1400 feet). It is, however, possible that the Esopus and Schoharie grits which at Becraft mountain have a combined thickness of 300 feet and are similarly barren in fossils, once continued northeastward into the Rensselaer grit trough. It must further be considered that the Rensselaer grit plateau represents a deposit in a long submeridional Appalachian trough. Its pebbles of coarse and fine gneiss came from a short distance and the numerous Lower Cambric pebbles probably from places north of the plateau. Its deposits suggest those of an embayment receiving its materials from the north. The entire absence of the fossils occurring in the nearby Becraft mountain formations favors this conception of estuarine conditions.

The evidence compels us to grant that the Rensselaer grit is of later than Siluric age; there is some good reason for regarding it an eastern deposit contemporary with the early Devonic, but the alternative proposition stands open, that its estuarine character and great thickness suggest

identity with the Catskill beds which stand sheer on the other side of the Hudson river in hights of several thousand feet and only 30 miles away from the outlier at Austerlitz.

*b* Dana indicated by the term "Worcester trough," a hypothetical Appalachian waterway in which the Carbonic beds of Worcester, Mass., eastern Massachusetts and Rhode Island were deposited. This is a more easterly northeast-southwest passage than the Connecticut trough and we can derive no satisfactory evidence of its existence during the Devonic. Indeed the statements made above indicate that, though this region may have been receiving deposits during the Cambric, it was a land body during the period with which we are now concerned and was not opened again for the reception of sediments till the beginning of the Carbonic. We are compelled therefore to dismiss the Worcester trough as having any bearing, from present evidence, on the theme before us.

*c* The Perry-St John-Annapolis Devonic channel, lying further to the south and east of those we have considered, is today represented by deposits still largely covered by the sea. Its far easterly course and its isolation seem to indicate that it had nothing in common with the rest, that it must have entered the southern Appalachians by a way of which we now know nothing.

12 We are thus impelled to conclude from the factors given that the line of passage southwestward from all the channel basins we have specially discussed, into the New York Helderbergian-Oriskany channel was by way of the Connecticut trough; that the Gaspé, Dalhousie, Aroostook and in a measure the Piscataquis-Somerset channels were independent isolated passages for a part of their distance only and that they converged eventually southward to contemporaneous or successive unity.

13 We have observed that the passage from New York through to Gaspé and New Brunswick was undisturbed during the earliest stages of the Devonic. Probably in the later stage represented by the extensive Grande Grève limestones it was less clear, the channel widened out into a basin of rapid propagation from which migration to the southwest took place freely. We believe the evidence fully indicates that during all these

stages of the Eodevonic the direction of migration was from the north inward and southward. Reference has been made to the occurrence of the Eodevonic on St Helens island, Montreal and to the presumption that it indicates the remnant of a backset along the St Lawrence trough of these waters, rather than any connection with New York through the Champlain trough. We find no reason for modifying this view as there is no single factor which presumes a paleozoic water connection along the Champlain graben during a period so late as the Devonic.

14 The Gaspé sandstones indicate (as we have suggested) a general breaking down of the barriers of the northern channel, by a transgression over the Silurian beds adjoining and a widening out of the area in such a way as to constitute in large part flood deposit or barachois conditions throughout the eastern part of the Gaspé peninsula. These conditions continued throughout the Middle Devonic as shown by the notable percentage of New York Hamilton species in these rocks commingled with highly typical survivors of the earlier or Grande Grève fauna. The New York species are here clearly the invaders, having entered this province by the still open waterway from the southwest. The remains themselves, whether of Grande Grève or Hamilton species, we regard as overwashed into their present position from outside the barrier bounding the barachois and not native to the sandy terrigenous sediments, abounding in plant remains, with which they are associated.

The numerical predominance of species in this fauna which can not be distinguished from those of Middle Devonic in the Appalachian gulf, seems to justify the interpretation given above, though the suggestion is not wanting that those species are allied to certain Coblentzian elements which bear close comparison with the New York Hamilton fauna I have had occasion to intimate that migration southwestward and westward from the German Coblentzian basin is adequate to explain the occurrence in later beds of certain of those species, and this proposition makes large demand for time lost in migration from east to west and would not, I judge, in view of the stratigraphy of the overlying conformable mass of Bonaventure deposits, materially alter the construction of the age of the Gaspé sandstone fauna.

## SUPPLEMENTARY NOTES

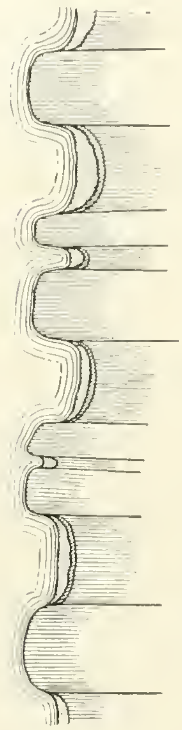
### THE FAULT AND INFALL AT L'ANSE AU SAUVAGE ON THE FORILLON, GASPÉ

L'Anse au Sauvage or Indian Cove lies a little more than half way between Grande Grève and Cape Gaspé on the Forillon peninsula. In my map of the Forillon I have shown only the limestone succession on this slender, half devoured mountain ridge. The Gaspé sandstone overlying these limestones does not appear in its normal attitude outside the headland of Little Gaspé which is 6 miles from the end of the Forillon. For all the extent of the Forillon this sandstone has been torn away by erosion leaving the banks of Grande Grève limestone sloping steeply into the waters of Gaspé bay.

L'Anse au Sauvage is one of the larger rock walled beaches of this coast which together form an array of singular scallops along the water front where the pounding of the sea has dislodged and consumed extensive joint blocks of the limestones. These blocks have been slightly tilted and often recemented by calcite and barite veins, sometimes carrying small quantities of galena and marcasite, and it is these little metalliferous veins along faces of jointing or slight displacement that have given birth to the many attempts which have been made to win silver and lead from these mountains. At L'Anse au Sauvage the end walls of the beach are the limestones but the long back wall measuring 350 feet presents a face of Gaspé sandstone faulted down into the limestones. The fault lines are well marked. At the western end is a pronounced

Sketch map of the Forillon showing the position of the infallen Gaspé sandstone among the Grande Greve limestones at L'Anse au Sauvage

crush zone of finely broken and mended limestone facing the compact blue limestone in which the break has occurred. Against the sheared and polished surface of this crushed mass lie the crumpled edges of the sandstones. At the eastern end is a down thrown mass of limestone with the sandstones above and behind it. This infallen remnant of the sandstone shows its presence further back on the mountain slope by a low depression whose sides converge upward into a triangle. The rocks are the gray green plant-bearing beds of the series, in some part filled with shale pebbles and all the strata tilted into an abnormal dip.



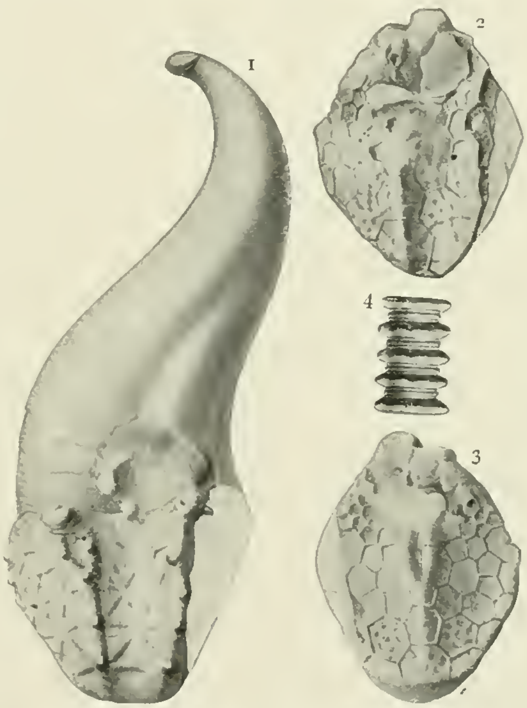
Diagrammatic sketch of the south sea face of the Forillon, indicating the origin of the little fishing beaches by differential sea erosion on the limestone blocks slightly tilted along joint planes transverse to the peninsula and to the strike of the strata

This is the only infaulted remnant of the former sandstone mantle known to me on this peninsula but the frequent occurrence of sandstone blocks and pebbles over the mountain slopes indicates that the limestones have not been clean swept of the debris of this ancient cover.

## CRINOID FROM THE GRANDE GRÈVE LIMESTONE

In all the census of the early Devonic faunas described in these volumes no Crinoidea have appeared. Their absence from the arenaceous beds is perhaps less surprising than the dearth of their remains in the heavy series of Grande Grève limestones. The occurrence here presented is thus not only of rather exceptional interest as the sole evidence of the crinoid species but is specially noteworthy for the parasitic combination of an enormous gastropod with this calyx. This specimen was observed by me exposed on the wave-worn surface of a steeply dipping and very compact layer of the Grande Grève limestones, lying beneath low water on the shores of Indian Cove, Gaspé. The calyx only, and that largely denuded of its calcareous substance, was exposed together with a considerable extent of stem. It was a matter of arduous and dampening gymnastics to extract the specimen. The gastropod appeared only after the specimen was detached from the layer. By

a mode of treatment which I have frequently used with success in elucidating the structure of calcareous fossils in a calcareous matrix it has been possible to produce the accompanying drawings of the internal cast of the calyx and the nearly complete exterior surface of the cup with the immense gastropod attached. In a recent discussion of symbiotic conditions among Paleozoic organisms I have given some attention to these singular consociations of gastropods with the Crinoidea and have illustrated a number of striking instances without attempting to exhaust the record of them,[1] but in all records there is no parallel to this for the extravagant disproportion between the size of the parasite and its host. Indeed it seems very probable that the growing weight of the gastropod (Orthonychia tortuosa Hall, a species before recorded from the fauna) finally so overbore the crinoid as to bring its head to the ground. Thus the parasitic act made the conservation of this unique specimen possible.



Melocrinus micmac L'Anse au Sauvage. 1 The exterior of the calyx and the attached gastropod, Orthonychia tortuosum. 2, 3 Opposite sides of the internal cast of the same calyx, showing the dome and the interior sculpture of the plates. 4 Fragment of the column

The crinoid is a Melocrinus of undescribed species. It may be known as M. micmac. The figure of the exterior shows the short sharp nodes at the centers of the radial series of plates and the radiating series of six ridges which traverse these and the rest of the calyx plates. Even some of the interradials are sharply nodose. Basals not preserved. Mr Edwin Kirk has examined this specimen and draws my attention to its

[1] The Beginnings of Dependent Life. N. Y. State Mus. 4th An. Rep't Director. 1908. p. 146–69, pl. 1–13.

similarity in ornament to the species M. tiffanyi described by Wachsmuth and Springer[1] from the Hamilton beds of New Buffalo, Iowa. That species however is without the spinate nodes and an ornament of six ridges radiating from the centers of the plates is not at all unknown in species of earlier Devonic age e. g. M. pachydactylus (Conrad) Hall [Palaeontology of New York v. 3, pl. 3, fig. 2] of the Helderbergian. The internal cast of this calyx exhibits in an interesting way the configuration of the interior of the plates and exposes the filling of the vault which was covered by the Orthonychia. The fragment of the column shows the alternating size of the disks and the scalloped edges of the major members.

[1] North American Crinoidea: Crinoidea Camerata. 1897. 1:299, pl. 22, fig. 7a, b.

# EXPLANATION OF PLATES

PLATE 1

**Dalmanites micrurus** Green

Page 18

1 A cephalon with characteristic border and lobation

2 Right free cheek with usual ornamentation

3 A somewhat distorted pygidium

**Proetus** sp.

Page 19

4-6 Pygidia probably representing distinct species. x 3

**Bronteus barrandii** Hall var. **major** Clarke

Page 18

7 Pygidium, natural size

**Pterygotus** sp.

Page 18

8 Fragment of a thoracic segment

**Orthoceras** cf. **longicameratum** Hall

Page 21

9 Upper or concave surface of one of the siphuncular beads. x 2

**Opercula of Euomphalus?**

Page 25

10-12 Three examples showing the concentric surface

**Platyceras** sp.

Page 24

13 A deeply furrowed shell comparable to P. retrorsum Hall

**Holopea** cf. **antiqua** Vanuxem var. **pervetusta** Conrad

Page 23

14-16 Three shells, natural size

**Holopea enjalrani** Clarke

Page 21

17-19 Three views of a typical example. x 1½

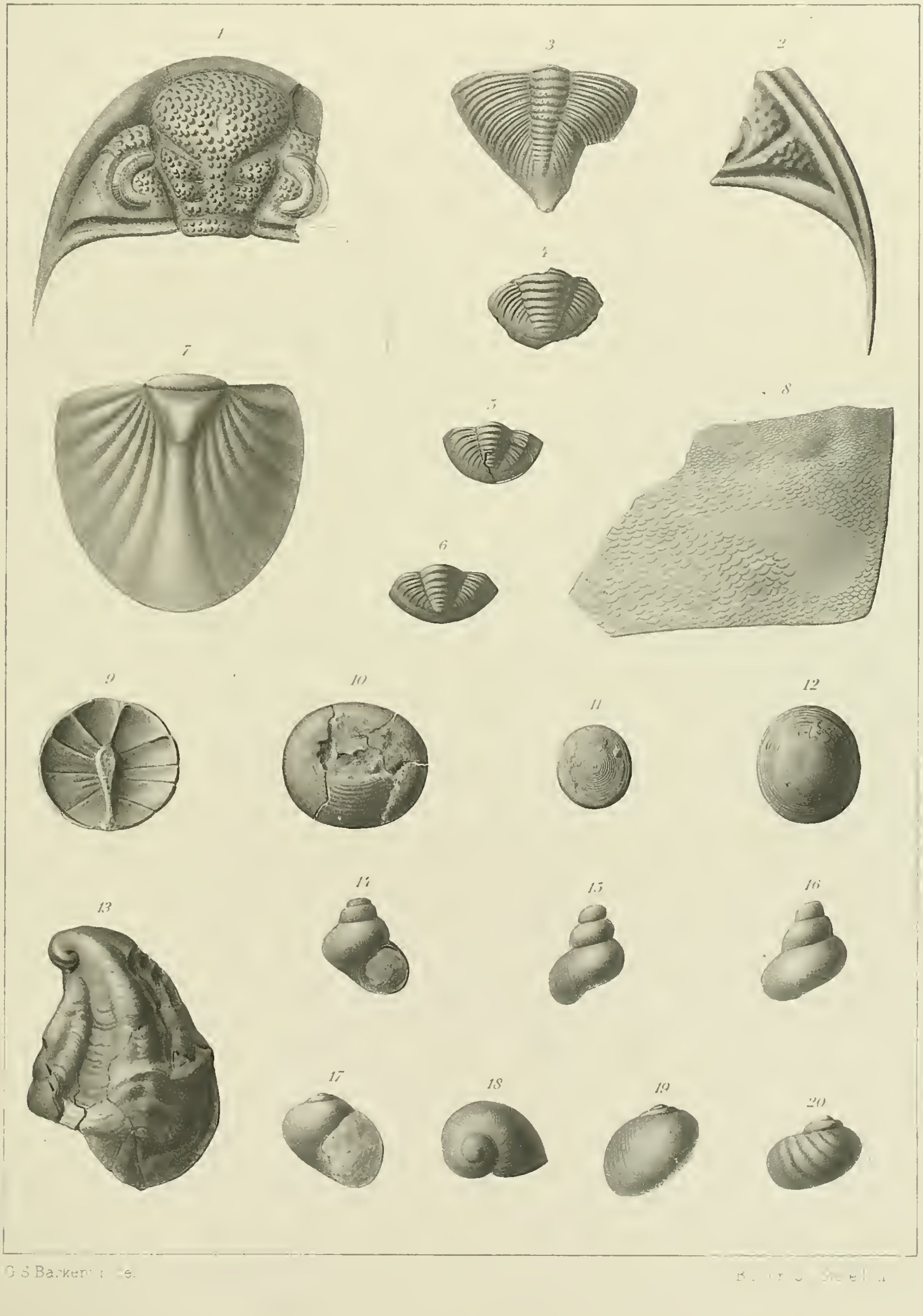
**Holopea enjalrani** var. **corrugata** Clarke

Page 22

20 A corrugated variety of the preceding

# DALHOUSIE BEDS






G S Barken[illegible]

PLATE 2

**Melissosoa compacta** (Hall)

Page 23

1–6 A series of shells showing the general form and style of growth

**Coelidium strebloceras** Clarke

Page 23

7 A very long and slender example

8 A specimen with the slit band very obscure

9 A small example with the slit band defined. x 2

**Euomphalus disjunctus** Hall

Page 24

10–14 A series of illustrations showing the form, ornament and cross-section of the shell

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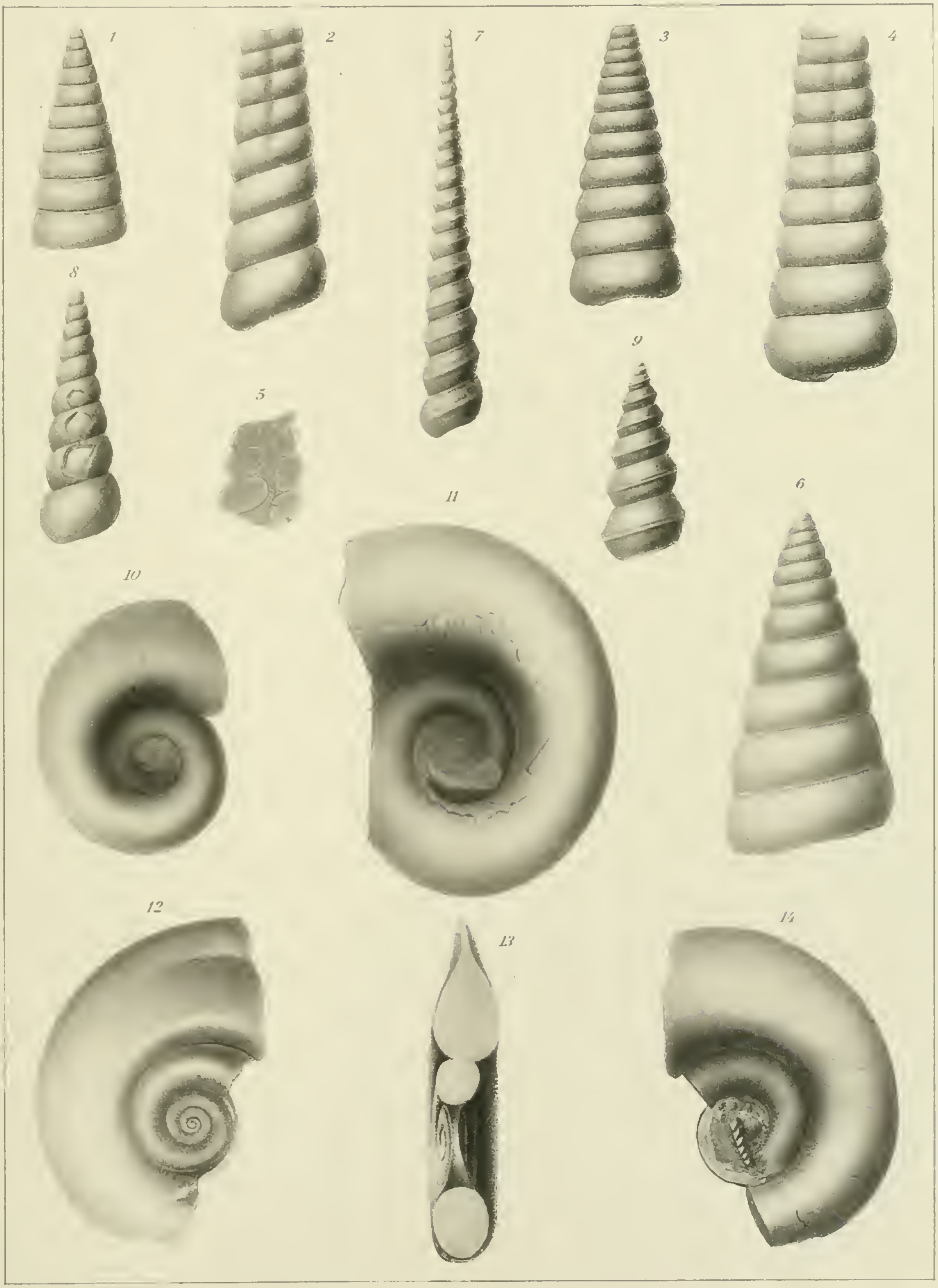


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PLATE 3

**Pterinopecten** cf. **proteus** Clarke and **wulfi** Frech

Page 26

1 A small left valve

**Pterinea** cf. **pseudolaevis** Oehlert

Page 26

2, 3 Left valves with suppressed anterior wing and suberect form

**Pterinea** sp.

4 A right valve whose specific relations are not clear

**Pterinea brisa** var. **vexillum** Clarke

Page 28

5, 6 Right and left valves

**Pterinopecten denysi** Clarke

Page 25

7 The left valve described

**Pterinea intercostata** Clarke

Page 26

8–12 A series of illustrations showing the variations to which this shell is subject

**Pterinea (Pteronitella?) incurvata** Clarke

Page 28

13–18 Illustrations of both valves

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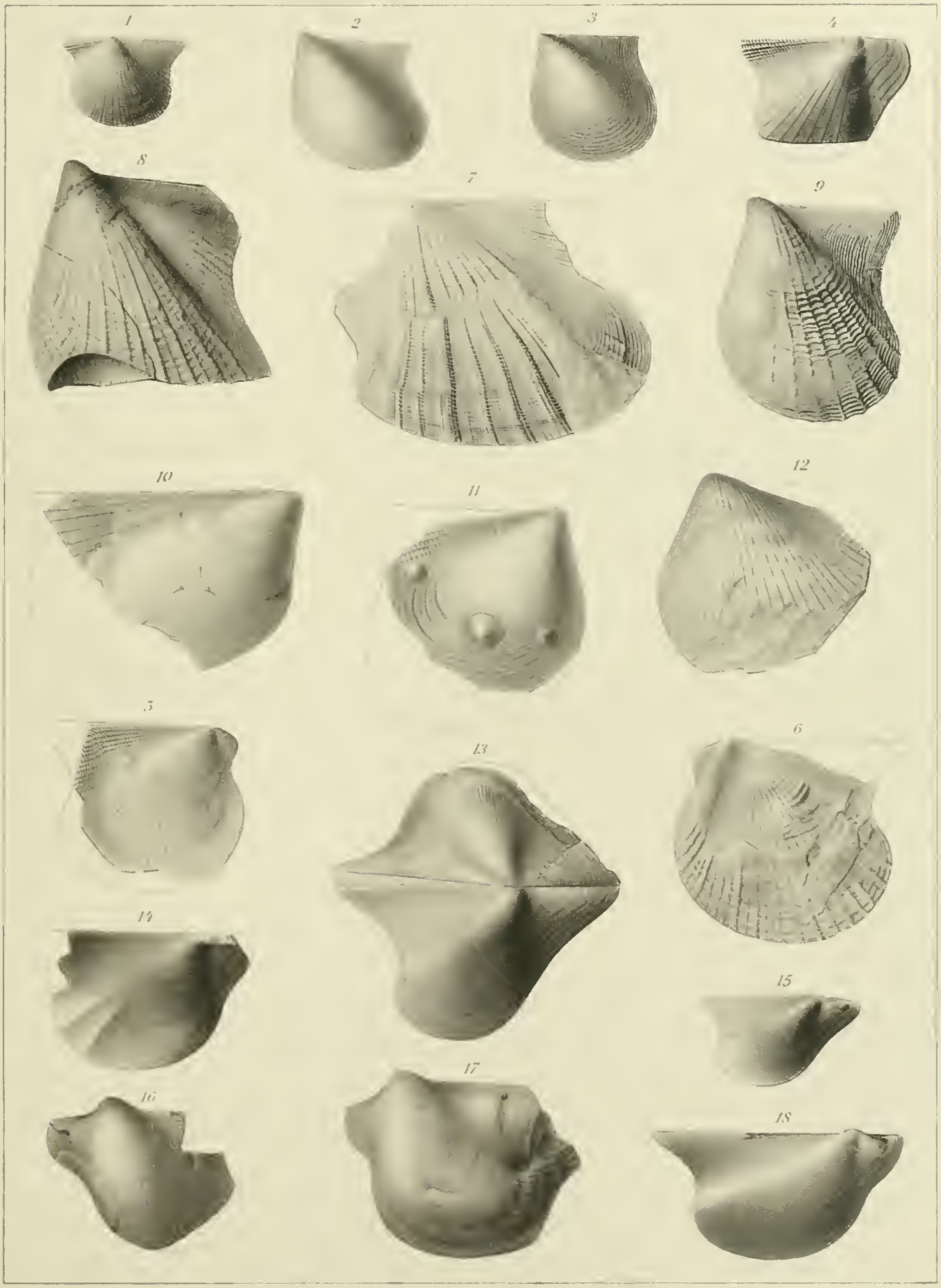


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## PLATE 4

### **Pterinea fasciculata** Goldfuss var. **occidentalis** Clarke

Page 27

1, 2 Left valves of usual size

3-5 Right valves showing the differences in sculpture in the two valves. Figures 4, 5, x 2

6, 7 Left valves, x 2, expressing the fasciculate ribbing

### **Pteronitella hirundo** Clarke

Page 29

8 A left valve

9 A right valve showing the characteristic form and strong radial hinge striae

10 A typical left valve

11 Conjoined valves, exposing an internal cast of the right and a sharp sculpture impression of the left

### **Pteronitella passer** Clarke

Page 30

12–14 Three left valves showing the subrhomboidal outline

### **Macrodus matthewi** Clarke

Page 34

15, 16, 18 Three right valves; 15, x $1\frac{1}{2}$; 16, 18, x 2

17 A left valve. x 2

### **Macrodus ? baileyi** Clarke

Page 34

19, 20 Right and left valves, natural size

### **Goniophora ?** sp.

21 A right valve

### **Goniophora curvata** Clarke

Page 31

22, 23 Two right valves

### **Sphenotus ellsi** Clarke

Page 32

24 A small right valve

25, 26 Specimens showing conjoined valves

# DALHOUSIE BEDS



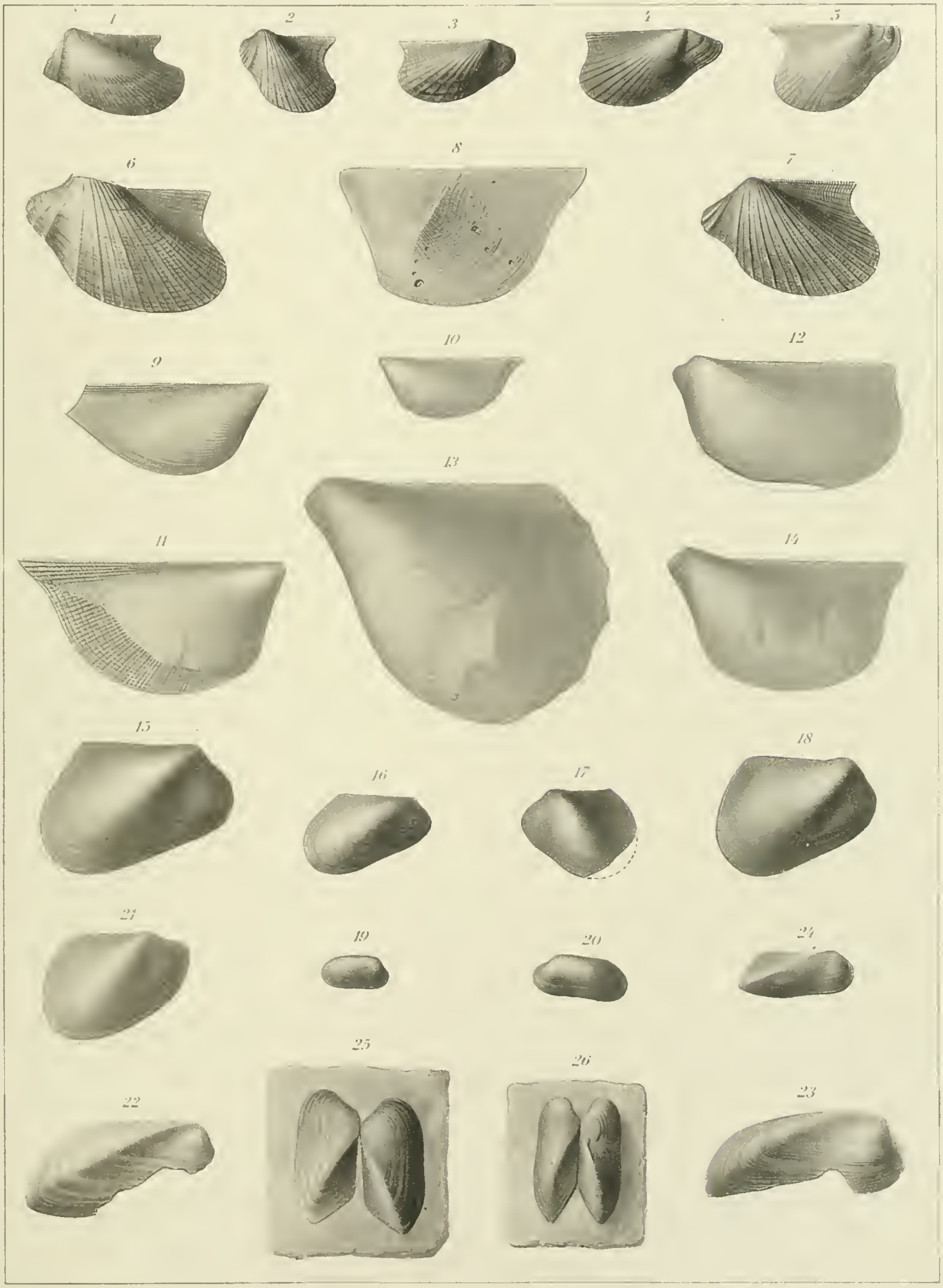


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PLATE 5

**Conocardium incarceratum** Clarke

Page 37

1, 2 Enlarged views showing the character of the sculpture. x 3

3 Cross-section of the shell showing the projecting vertical lamellae

4, 5 Valves of other specimens

**Carydium gregarium** Beushausen

(*See* plate 33)

Page 33

6–12 A series of illustrations all x 2 except figure 8

**Carydium elongatum** Clarke

Page 33

13–17 Shells of this species natural size, except figures 13 and 15, x 3

**Mytilarca dalhousie** Clarke

Page 30

18, 20 Interior and exterior of the same shell

19 Enlargement of hinge

21, 22 Exteriors of other specimens

**Grammysia** sp.

23 Sculpture cast of a large obscure shell of this genus

# DALHOUSIE BEDS



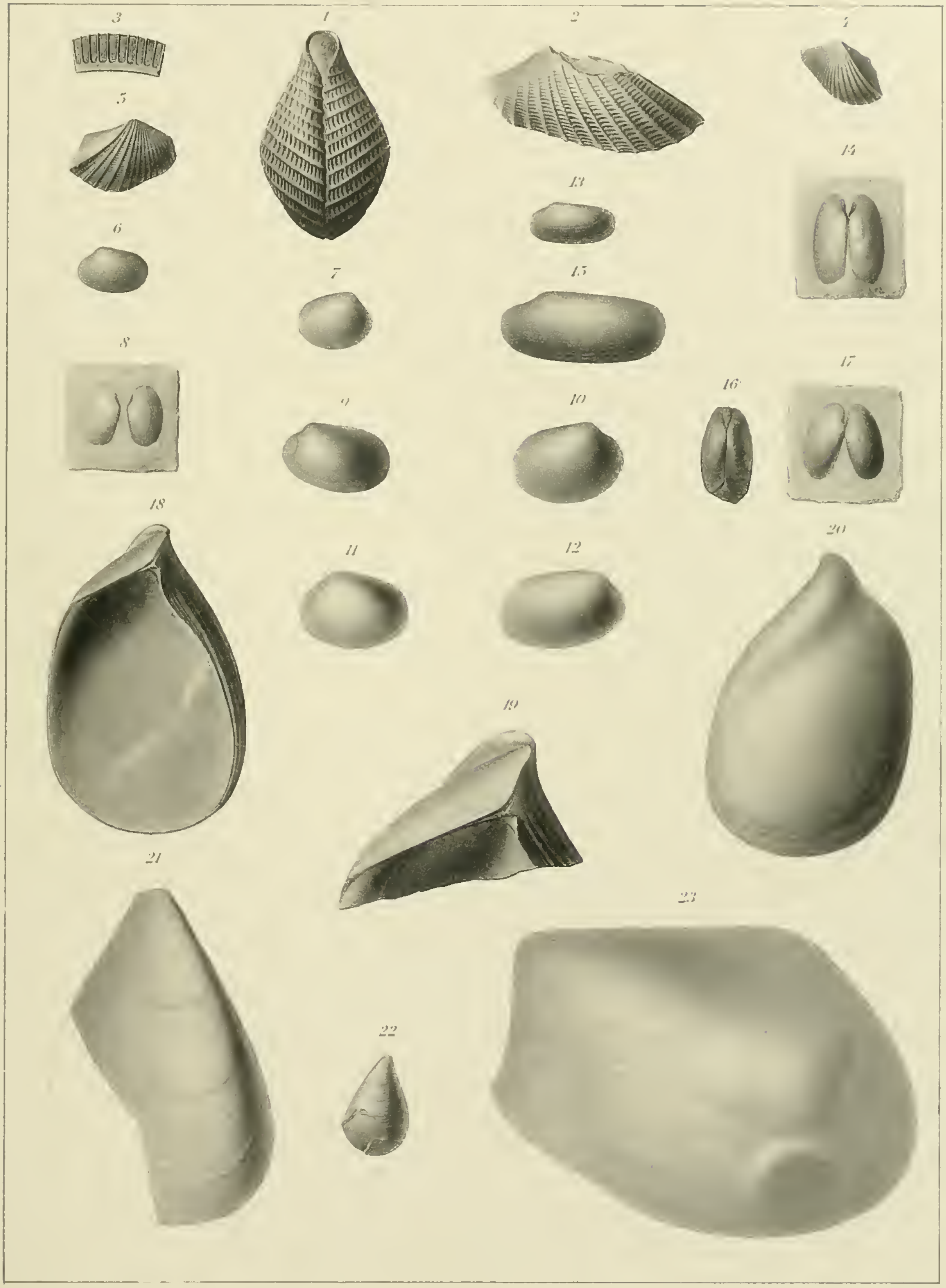


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PLATE 6

**Cypricardella norumbegae** Clarke

Page 34

1, 2 Left valves, the latter retaining a portion of the thick shell substance

3, 4 Right valves

**Edmondia ?** sp.

5 Internal cast of a large right valve of uncertain generic relations

9, 10 Two views of a shell which seems to be allied to the foregoing

**Modiomorpha impar** Clarke

Page 31

6–8 A right and two left valves of this species

**(Pectunculus ? ?) plutonicus** nov.

Page 35

11, 12 Cardinal and profile views of the specimen described

# DALHOUSIE BEDS



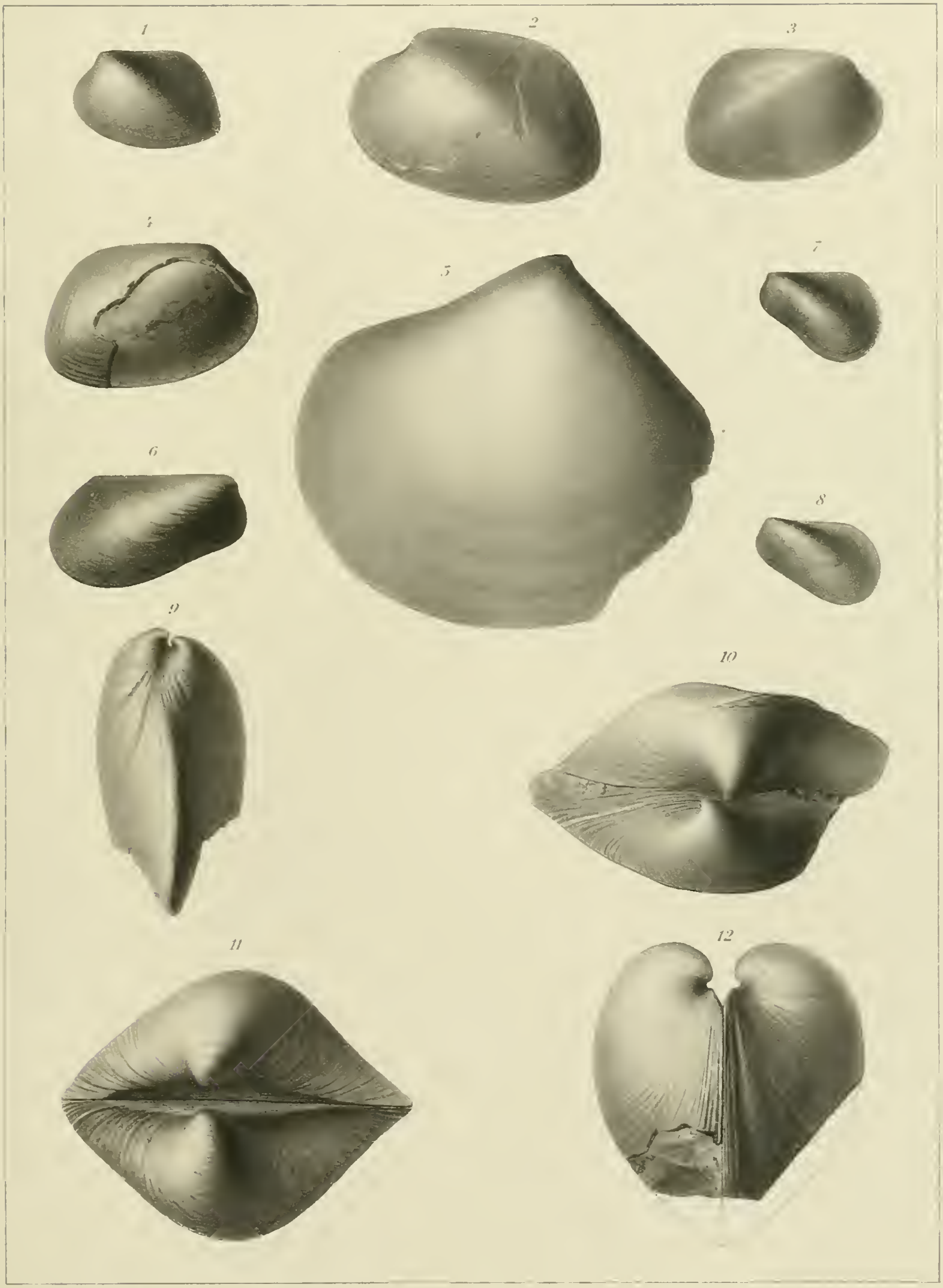


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PLATE 7

**Palaeoneilo (Nuculites) folles** Clarke

Page 36

1–3 Left and right valves and internal cast, natural size

**Nuculana (Ditichia) securis** Clarke

Page 37

4–9 Lediform shells showing in most the impression of the clavicle on the posterior slope, in figure 6 on the anterior slope

**Rensselaeria stewarti** Clarke

Page 38

10–12 Three views of the exterior. x 1½

13, 14 Dorsal and profile views of a smaller shell

15, 16 Exteriors of ventral valves

17, 18 Internal cast of ventral valve showing the cardinal flattening or pseudoarea and the character of the muscle scars

19 Internal dorsal cast, showing cardinal area and muscle scars

20 Enlargement of the dorsal cardinal cast showing the area and the filling of the perforation of the cardinal plate

**Trematospira perforata** Hall var. **atlantica** Clarke

Page 41

21, 22 Opposite sides of the same shell

23 Cardinal view of conjoined valves

**Sieberella pseudogaleata** Hall

Page 39

24, 26 Views of a ventral valve

25 The dorsal valve showing septa

**Cyrtina chalazia** Clarke

Page 40

27–32 Three views each of two shells (27–29, 30–32). x 1½

# DALHOUSIE BEDS



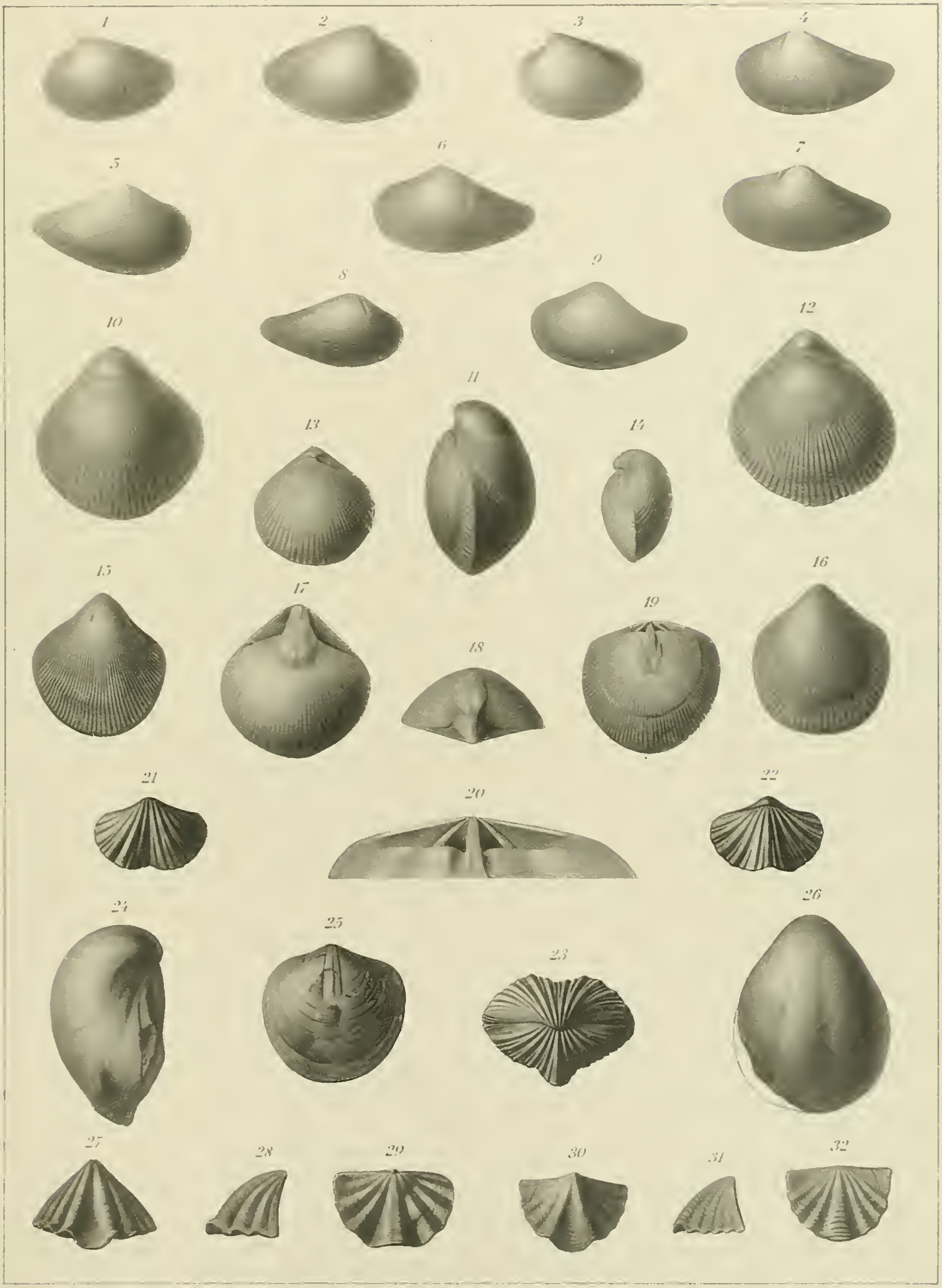

PLATE 8

**Spirifer concinnus** Hall

Page 39

1, 2 Cardinal views of the ventral valve, showing the deltidium (fig. 2, x 1½)

3 A young shell x 2, showing the concentric fimbriations

4 A small dorsal valve

5–12 Views of adult shells

13, 16 Enlargements of the surface of the cardinal area and its characteristic sculpture

14 Internal cast of a ventral valve

15 The external surface enlarged to show the finely fimbriate surface in the adult condition. x 5

**Spirifer perlamellosus** Hall

Page 40

17 Exterior of a ventral valve

18 The fimbriate surface. x 10

19 A small ventral valve

20 Cardinal view of an adult shell

**Stropheodonta varistriata** Conrad

Page 43

21 A small shell, essentially a cast of the exterior of the dorsal valve but retaining the shell at the beak. x 3

22 A small ventral valve x 3

23, 24 Somewhat exfoliated interiors of dorsal valves

# DALHOUSIE BEDS



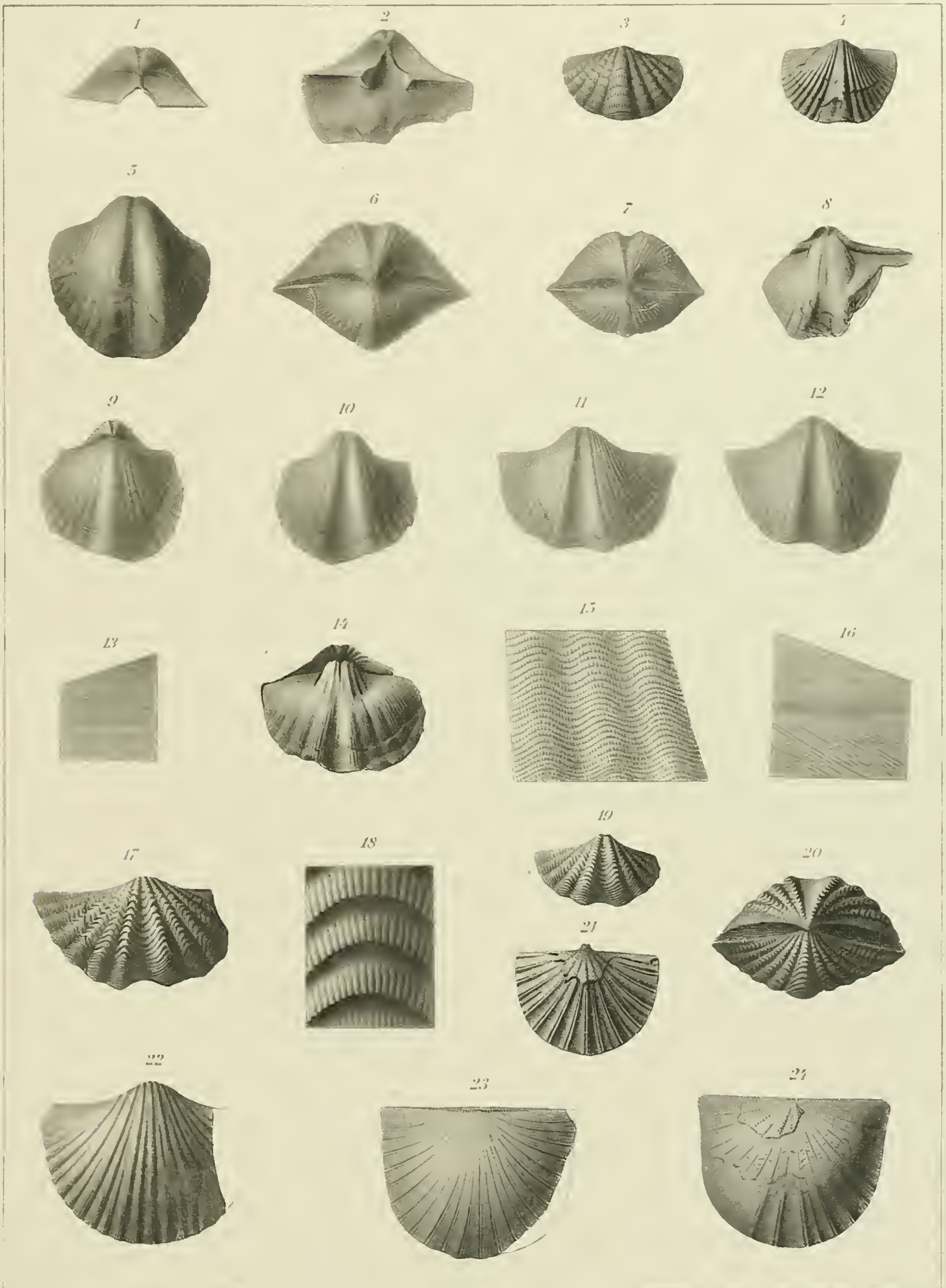

PLATE 9

**Stropheodonta patersoni** Hall protype **bonamica** Clarke

Page 44

1–3 Profile, top and posterior views of a specimen with the radial sculpture in elementary expression and showing well defined umbonal corrugation

4–6 Posterior, top and profile views of a specimen with the sculpture characters in more mature development

**Stropheodonta (Brachyprion) schuchertana** Clarke

Page 45

7–9 Three views of a typical ventral valve

10–12 Ventral valves, somewhat incrusted with Monticulipora and Hederella

**Stropheodonta (Brachyprion) major** Clarke

Page 45

13–15 Views of the ventral valve

**Strophonella punctulifera** (Conrad)

Page 45

16 Partial sculpture cast of the interior of the ventral valve

17 Cardinal view of conjoined valves

18 Ventral view of the conjoined valves

# DALHOUSIE BEDS



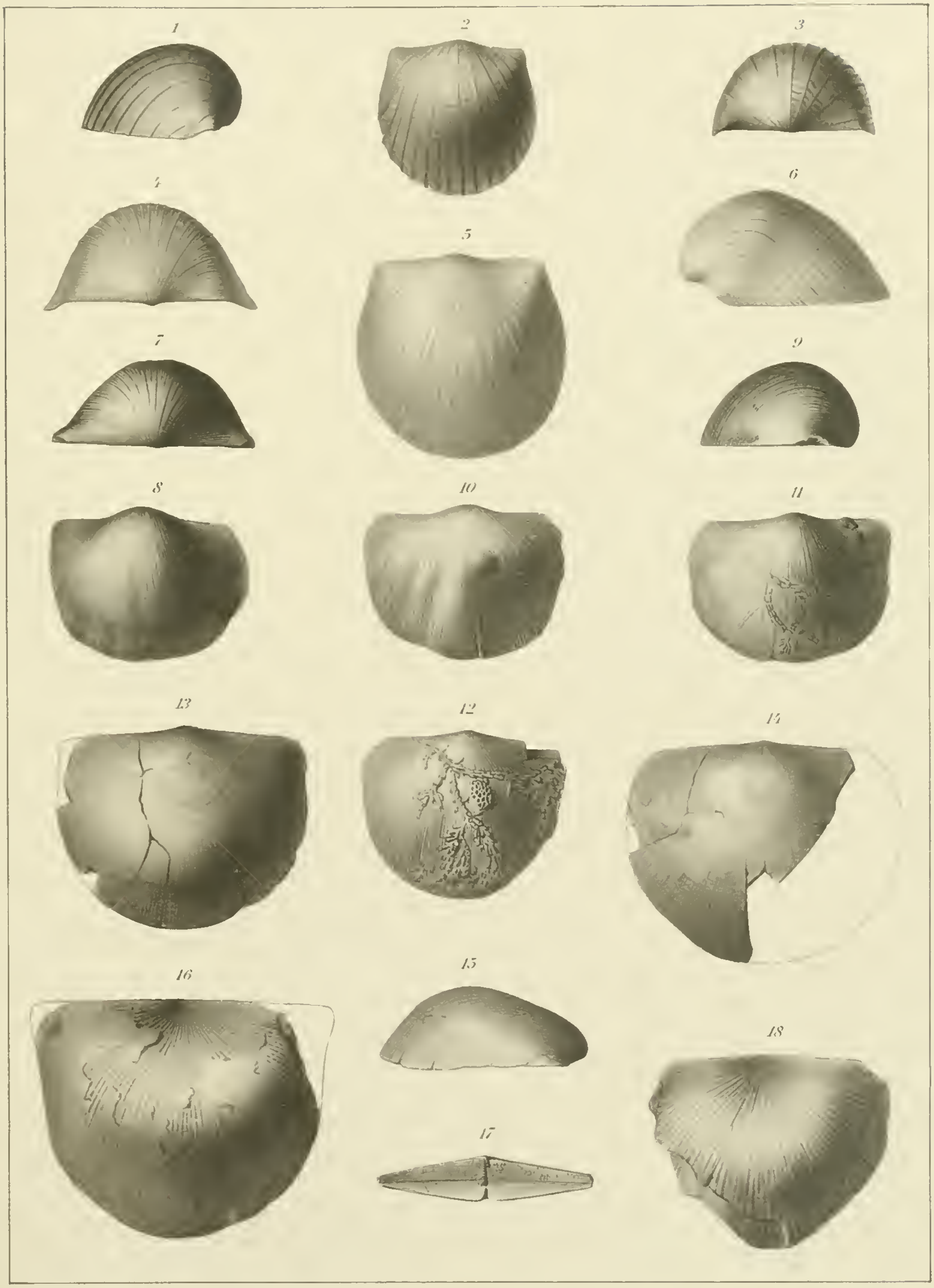


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PLATE 10

**Leptaena rhomboidalis** Wilckens

Page 45

1–4 Cardinal and profile views of two shells of usual size

5, 6 Larger individuals

**Leptaenisca concava** Hall

Page 46

7 Interior of a ventral valve. x 1½

8, 9 Cardinal and upper views of the ventral valve showing cicatrix of attachment and the umbonal distortion. x 1½

10, 11 Similar views of an older shell

**Schizophoria multistriata** Hall

Page 47

12–18 A series of illustrations showing the general character of the shells in these beds. Figure 14 is an enlargement of the punctate surface

**Rhipidomella hybridoides** Clarke

Page 47

19–28 Of these illustrations figures 24, 25, 26 are views of the same shell enlarged x 2. Others are natural size

# DALHOUSIE BEDS

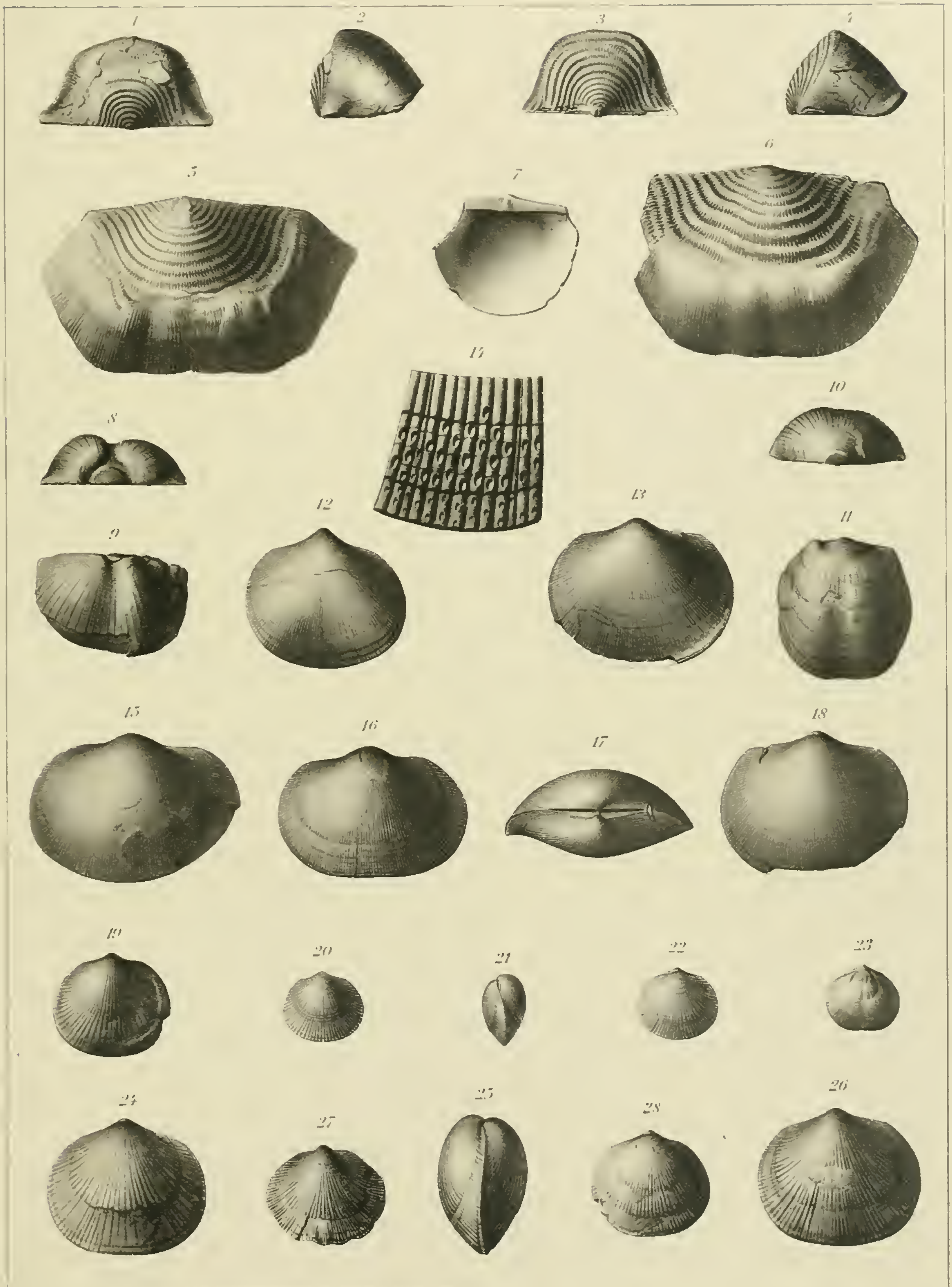


PLATE 11

**Rhipidomella numus** Clarke

Page 47

1, 2 Opposite sides of a young example. x 3

3 A shell of average proportions

4 Interior of a ventral valve

5, 6 Opposite sides of an average shell

7–9 Three views of an uncompressed specimen

10–12 Three views of a well preserved shell enlarged ½ diameter to show the character of the surface

**Orbiculoidea** sp.

Page 48

13, 14 Two pedicle valves

**Marine alga ?**

Page 51

15 Small fragment of a frond. x 5

16 A rock surface bearing a mass of these filaments

# DALHOUSIE BEDS .

Plate II

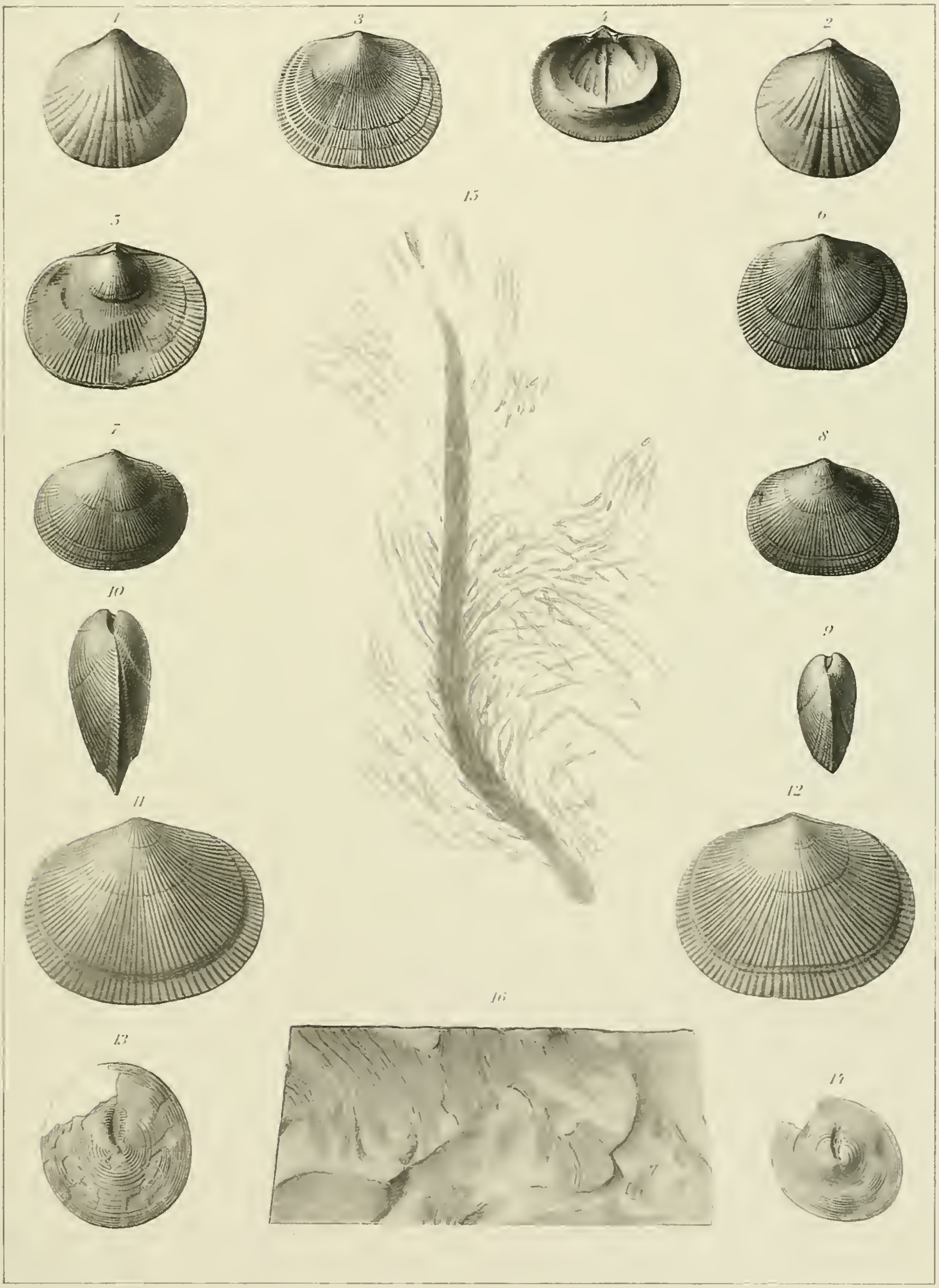


PLATE 12

**Homalonotus** cf. **vanuxemi** Hall

(*See* plate 22)

Page 67

1 Fragment of a cephalon

*Locality.* Matagamon lake

**Dalmanites pleuroptyx** Green

Page 66

2 A slightly distorted cephalon with very characteristic frontal crenulations

*Locality.* Blind Cove point, Telos lake

3, 4 Pygidia of this species

*Locality.* Folsom farm, Moosehead lake

**Dalmanites ploratus** Clarke

Page 66

5 A pygidium showing the characteristic surface

*Locality.* Matagamon lake

**Dalmanites** sp. nov.

Page 67

6 An incomplete pygidium with sparse coarse ribs and slender caudal spine

*Locality.* Blind Cove point, Telos lake

**Dalmanites** sp.

Page 67

7 A well segmented pygidium with rounded and upturned caudal extremity

*Locality.* Matagamon lake

**Dalmanites** sp.

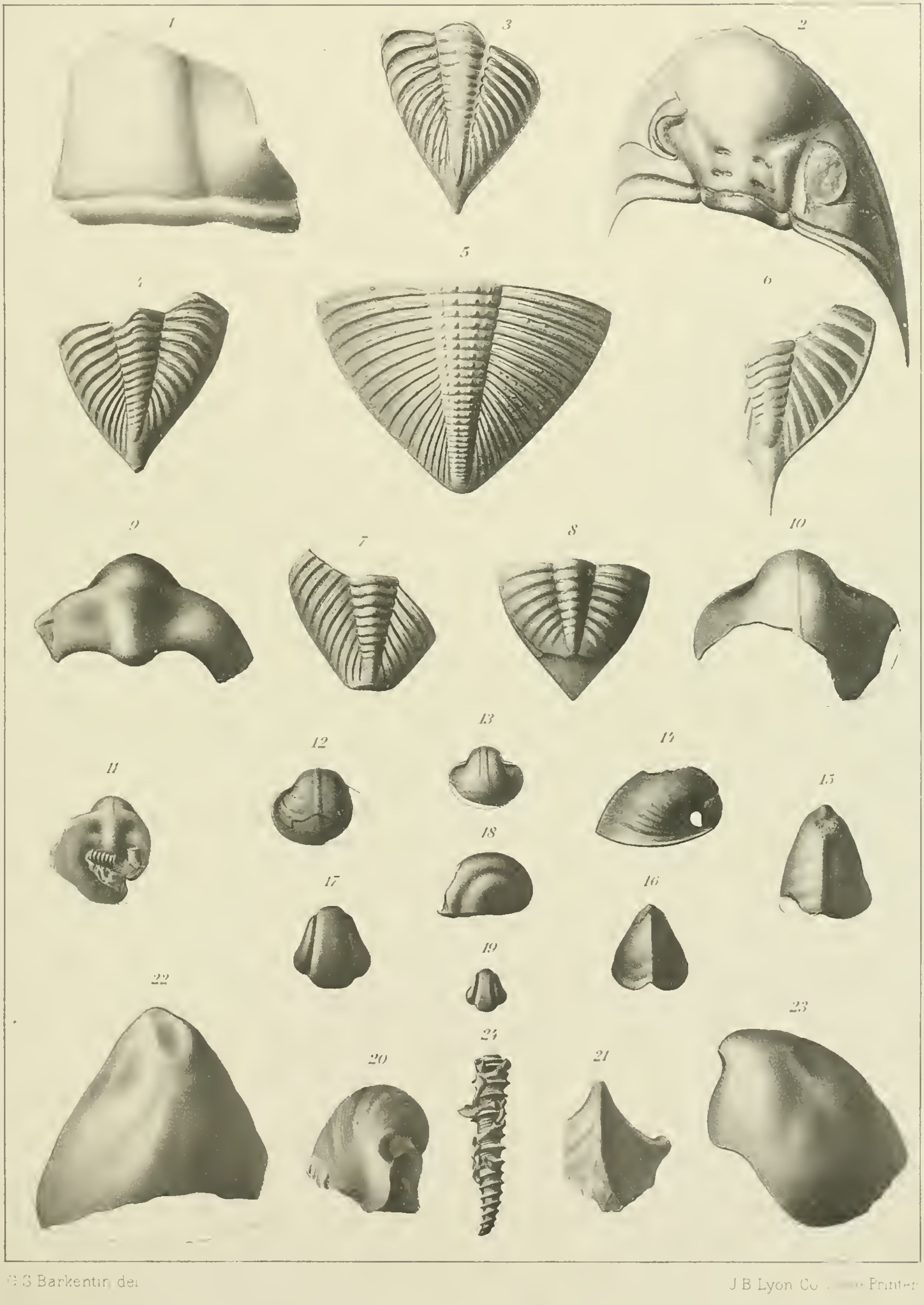
Page 67

8 A pygidium of an unrecognized species

*Locality.* Tomhegan point, Moosehead lake

MOOSE RIVER SANDSTONE



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**Phragmostoma diopetes** Clarke

Page 70

9 The thickened tabular callus on the inner lip of the shell. x 2

10 The exterior of an incomplete example. x 2

11 A view showing the general aspect of the stoma and its calloused lip

12, 13 Small examples of this species

*Locality.* Matagamon lake

**Cyrtolites expansus** Hall

Page 69

14, 15 Profile and dorsal views of a characteristic example

16 A smaller specimen

*Locality.* Cunningham's camp near Matagamon lake

**Plectonotus derbyi** Clarke

(*See* plate 24)

Page 69

17–19 Views of the usual expression of this shell

*Locality.* Matagamon lake and Cunningham's camp

**Tropidodiscus** cf. **obex** Clarke

(*See* plate 22)

Page 69

20, 21 Profile and dorsal views of a specimen referred to this species

*Locality.* Matagamon lake dam

**Platyceras** cf. **calantica** Hall and **hebes** Clarke

(*See* plate 22)

Page 68

22, 23 Two views of the same specimen

*Locality.* Cunningham's camp near Matagamon lake

**Cornulites** sp.

Page 67

24 A large tube overgrown with an auloporoid coral

*Locality.* Near Blind Cove point, Telos lake

PLATE 13

**Aviculopecten flammiger** Clarke

Page 71

1, 3 Two left valves showing some difference in the expression of the sculpture, figure 1 indicating a longer retention of the primitive characters

*Localities.* Figure 1, Askwith siding; figure 3, Misery stream

2 Enlargement of sculpture from figure 3. x 5

4 A larger valve referred to this species

*Locality.* Telos lake

**Aviculopecten alcis** Clarke

Page 70

5 A left valve, somewhat incomplete, showing the character of the surface

*Locality.* Seven miles north of Kineo, Moosehead lake

**Pterinea moneris** Clarke

Page 73

6 Part of internal cast of right valve showing the hinge teeth

*Locality.* Matagamon lake

7 Sculpture cast of the left valve

8, 9 A similar specimen showing the cast of the hinge with enlargement

*Locality.* Webster lake

**Pterinea radialis** Clarke

(*See* plate 14)

Page 72

10 A small left valve

11 Internal cast of a left valve

14 A large left valve

*Localities.* Matagamon lake and Cunningham's camp

**Pterinea** sp.?

12 Sculpture cast of a left valve showing teeth and ligament area

*Locality.* Matagamon lake

13 A left valve

*Locality.* Stony brook, Moose river

These two specimens are allied in some particulars both to each other and to P. radialis

# MOOSE RIVER SANDSTONE



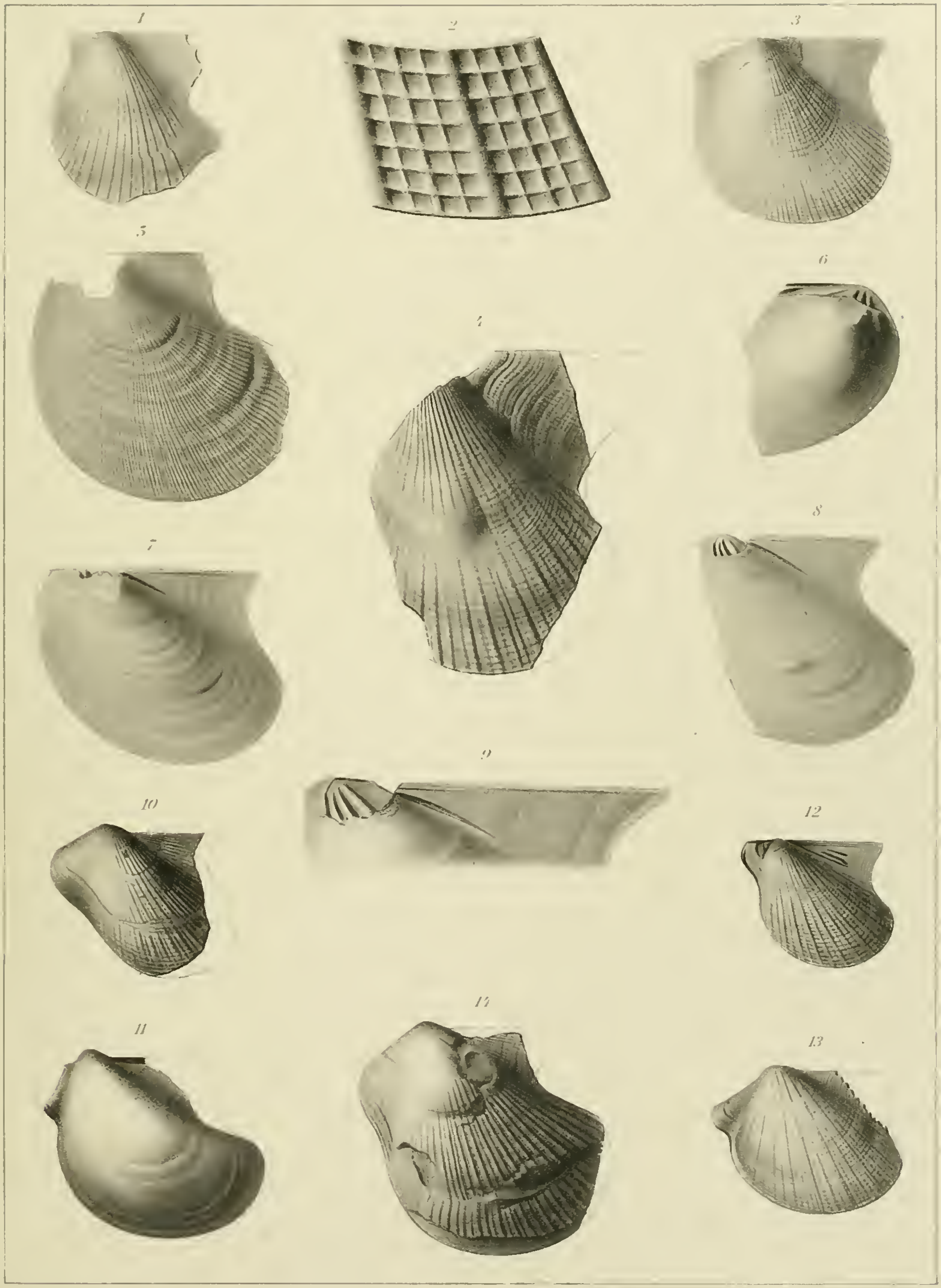


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PLATE 14

**Pterinea radialis** Clarke

(*See* plate 13)

Page 72

1 A left valve with beak removed showing cast of the hinge
*Locality.* Matagamon lake, 1 mile above dam on east side

2 Another left valve with finer radial striae
*Locality.* Moosehead lake, 7 miles north of Kineo bay

**Pterinea mainensis** Clarke

Page 71

3 A young left valve
*Locality.* Blind Cove point

4 Internal cast of left valve showing the hinge
*Locality.* Telos lake dam

5, 6 Left valves of old individuals
*Locality.* Moosehead lake, 7 miles north of Kineo bay

7 A right valve from the same locality as the last

**Aviculopecten** cf. **gebhardi** (Hall)

Page 70

8 Sculpture cast of a small right valve

9 A large incomplete coarse ribbed left valve
*Locality.* Cunningham's camp, near Matagamon lake

# MOOSE RIVER SANDSTONE



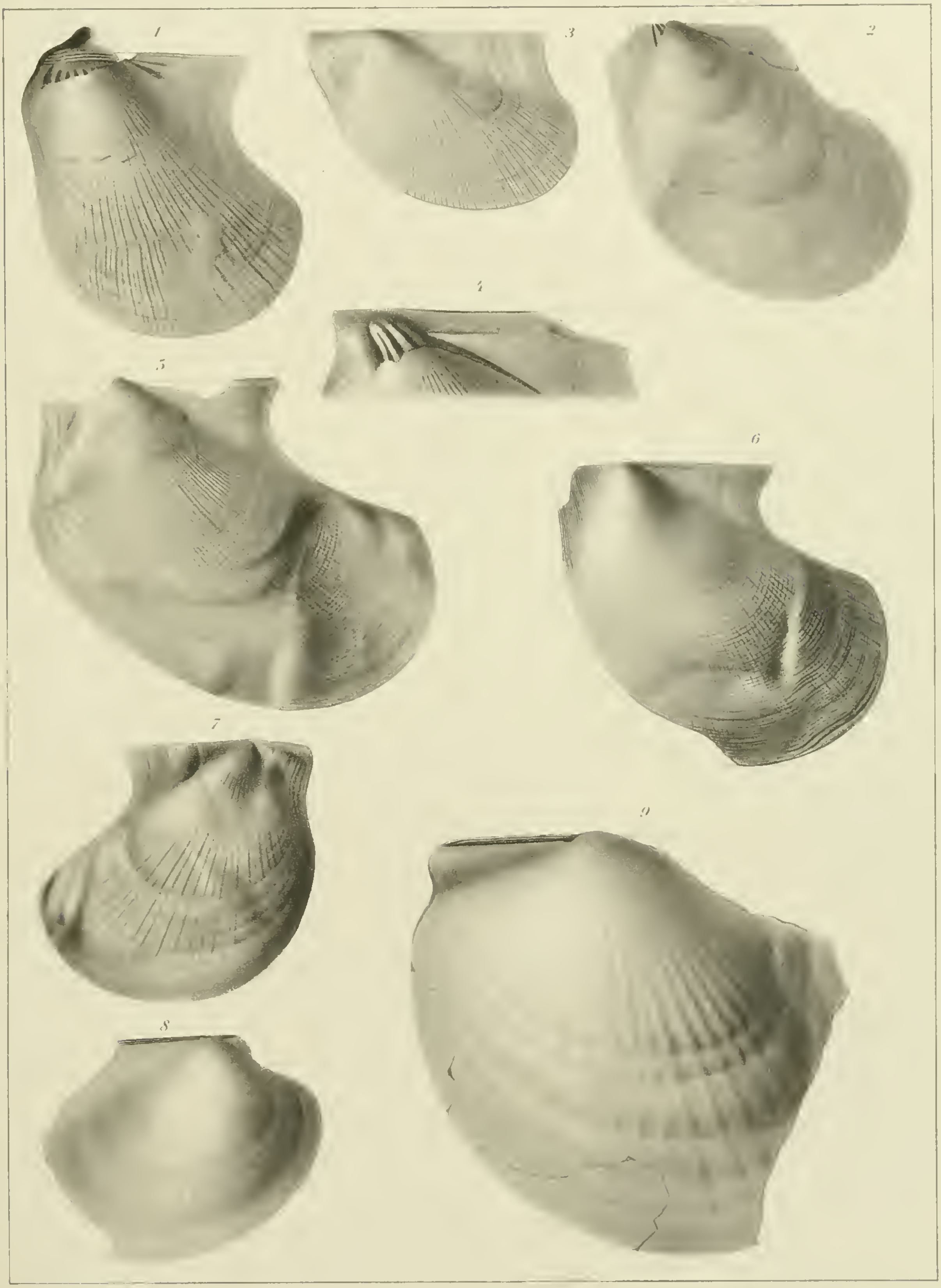


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PLATE 15

**Cyrtodonta muscula** Clarke

Page 74

1–3 Internal casts of both valves with enlargement of hinge

*Locality*. . Seven miles north of Kineo, Moosehead lake

**Cyrtodonta beyrichi** Beushausen

Page 73

4 Internal cast of right valve

5, 6 A left valve with cast of hinge exposed and enlarged

*Locality*. Seven miles from Kineo, Moosehead lake

**Cardiomorpha (Goniophora ?) simplex** Clarke

Page 77

7, 9 Left valves showing outline and proportions, muscle and pallial scars

8 Internal cast of expanded valves showing muscle scars and the filling of the prodissoconch

10 Enlargement of part of a similar cast showing details of the striated ligament surface and entire absence of denticulations. x 1½

11 Enlargement of anterior portion of another cast showing the details of the anterior adductor and foot scars, of the ligament area and the filling of the prodissoconchs. The transverse striated band in front is a portion of the matrix.

*Localities*. Tomhegan and Soccatean points, Moosehead lake

**Cypricardinia magna** Clarke or cf. **crenistriata** Sandberger

Page 76

12, 13 Two right valves

*Locality*. Baker Brook point, Moosehead lake

**Modiomorpha odiata** Clarke

(*See* plate 16)

Page 74

14 Right valve

15 Left valve

*Locality*. Tomhegan point, Moosehead lake

# MOOSE RIVER SANDSTONE



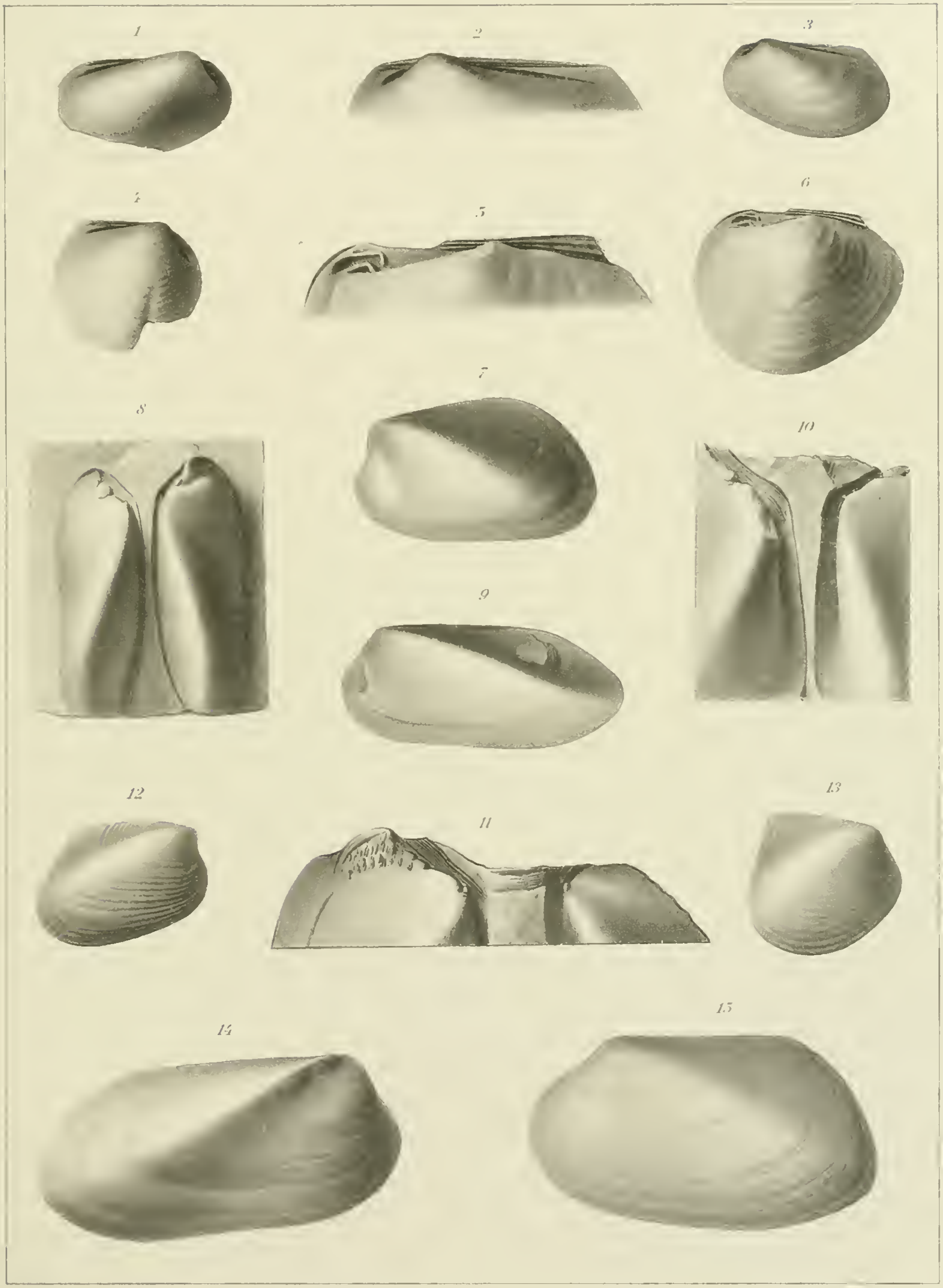


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PLATE 16

**Modiomorpha odiata** Clarke

(*See* plate 15)

Page 74

1-4 Internal casts of both valves showing the umbonal tooth and socket and the long posterior dental ridge and grooves

*Locality.* Matagamon lake, east side, 1 mile above dam

5 A small right valve

*Locality.* Matagamon lake dam, south side

**Leptodomus prunus** Clarke

Page 76

6 Expanded conjoined valves

*Locality.* Blind Cove point

**Ditichia** cf. **elliptica** Maurer

Page 78

7, 8 Internal casts of both valves showing the extreme development of the clavicular ridges and the broad row of ligament pits

*Locality.* Matagamon lake, east side, 1 mile above dam

**Cypricardella parmula** Clarke

Page 77

9-12 A series of internal casts showing the form of the shell and the nature of the hinge

*Locality.* Near Soccatean point, Moosehead lake

**Prosocoelus** cf. **orbicularis** Beushausen

Page 75

13 Sculpture cast of a right valve

*Locality.* Tomhegan point, Moosehead lake

**Prosocoelus pes-anseris** Zeiler & Wirtgen var. **occidentalis** Clarke

Page 75

14, 15 Sculpture and internal casts of this species

*Locality.* Tomhegan point, Moosehead lake

# MOOSE RIVER SANDSTONE



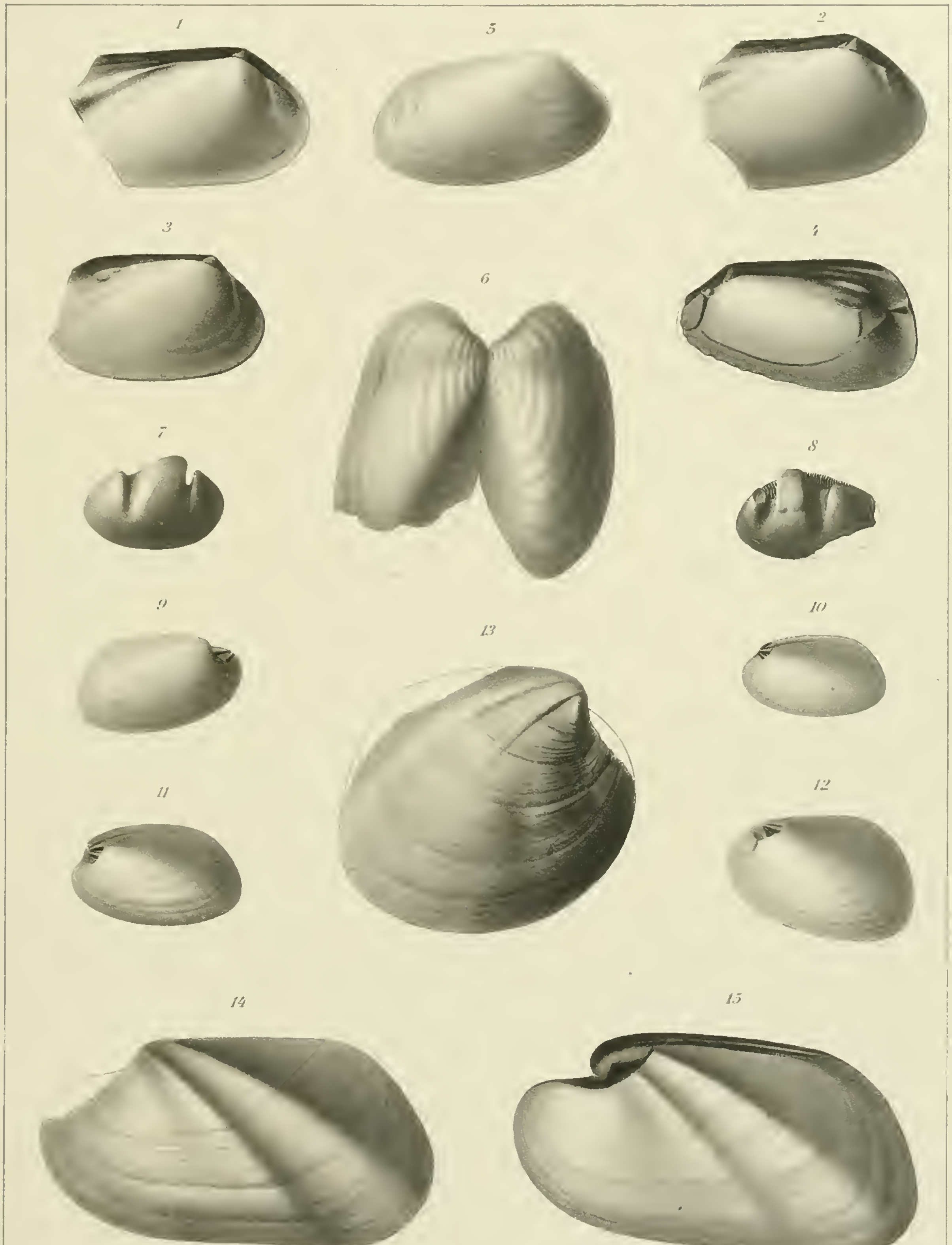


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PLATE 17

**Solenopsis** sp.

Page 78

1 A right valve of a species of this genus

2 Fragment of a right valve which may represent another species of the genus

*Locality.* Baker Brook point, Moosehead lake

**Palaeosolen simplex** Maurer

(*See* plate 28)

Page 77

3, 4 Left and right valves

*Locality.* Near Soccatean point, Moosehead lake

**Palaeopinna flabellum** Hall

Page 74

5, 6 Lateral and anterior profile views of conjoined valves

*Locality.* Seven miles north of Kineo, Moosehead lake

**Rensselaeria** cf. **crassicosta** Koch

Page 80

7 Internal cast of dorsal valve

8, 9 Lateral and top views of the internal cast of a ventral valve

*Locality.* Misery stream

**Rensselaeria ovoides** (Eaton)

Page 79

10–12 Casts of ventral valves showing proportions and character of muscle and cardinal structures

*Locality.* Cunningham's camp, near Matagamon lake

**Rensselaeria callida** Clarke

Page 79

13, 14 Profile and dorsal views of an internal cast

15–17 Ventral, profile and dorsal views of a smaller example

*Locality.* Misery stream

# MOOSE RIVER SANDSTONE



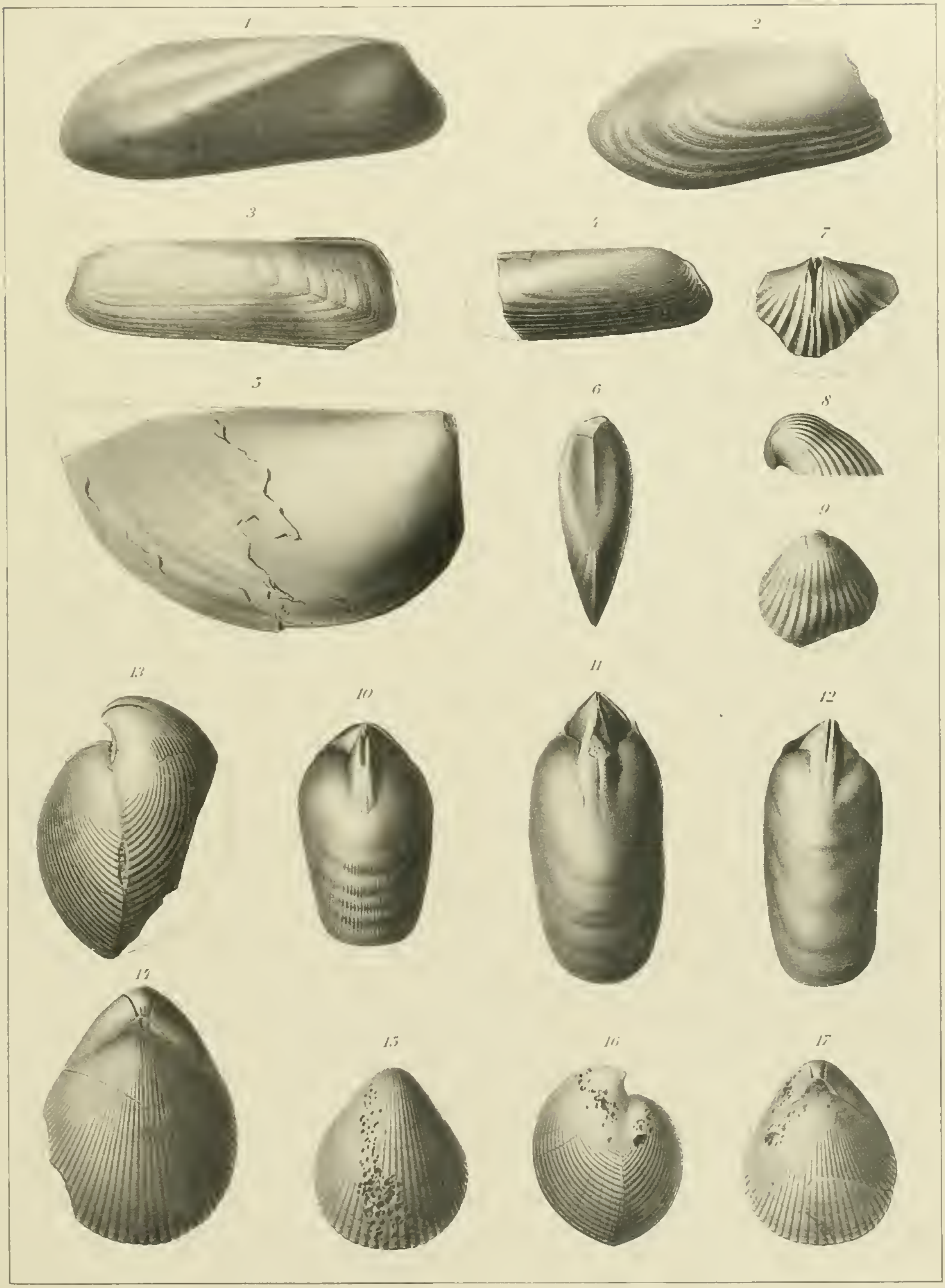


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PLATE 18

## Rensselaeria cf. stewarti Clarke

(See plate 7)

Page 7[illegible]

1–3 Three views of internal casts of a shell very closely allied to R. stewarti of the Dalhousie fauna. All x $1\frac{1}{2}$

*Locality.* Near Soccatean point, Moosehead lake

## Rensselaeria diania Clarke

Page [illegible]

4–6 Views of internal casts showing the characters of the species

*Locality.* Misery stream, town of Sandwich

## Rensselaeria (Amphigenia) parva Clarke

Page 81

7, 8 Internal casts of dorsal and ventral valves, showing the normal a very slender outline

*Locality.* Tomhegan point, Moosehead lake

9 Umbonal portion of a dorsal cast, showing the impression of the perforated hinge plate. x 2

*Locality.* Stony brook, Moose river

10 Internal cast of a ventral valve

*Locality.* Stony brook, Moose river

11–13 Casts of ventral valves showing approximate septa and perforated hinge plate

*Locality.* Near Soccatean point, Moosehead lake

## Megalanteris cf. ovalis Hall

Page 81

14 Internal cast of dorsal valve

15, 16 Opposite sides of an internal cast of both valves

*Locality.* Telos lake dam

## Spirifer perimele Clarke

Page 84

17, 18 A dorsal valve and enlargement of its sculpture

19, 20 Sculpture casts of dorsal valves

21 Internal cast of ventral valve

*Locality.* Tomhegan point, Moosehead lake

MOOSE RIVER SANDSTONE



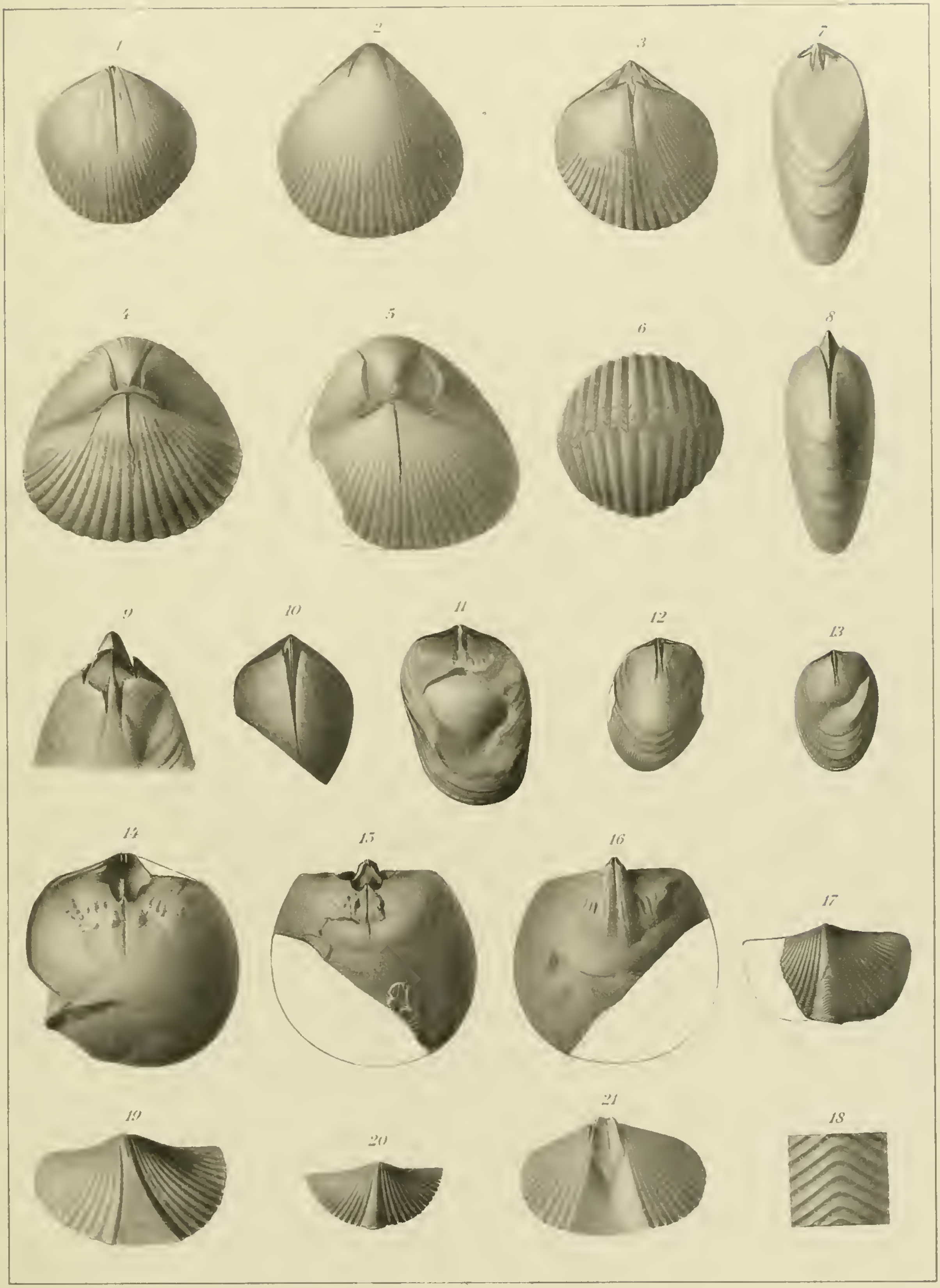


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PLATE 19

**Spirifer arenosus** (Conrad)

Page 83

1 Large smooth internal cast of a ventral valve

2, 3 Dorsal and profile views of conjoined valves, the ventral valve being preserved as an internal cast

4 Internal cast of dorsal valve

*Locality.* Cunningham's camp, near Matagamon lake

**Spirifer primaevus Steininger** var. **atlanticus** Clarke

(*See* plate 20)

Page 82

5–12 A series illustrating the internal (5, 6, 9, 10, 11) and external (7, 8, 12) characters of this shell

*Locality.* Tomhegan point, Moosehead lake

# MOOSE RIVER SANDSTONE



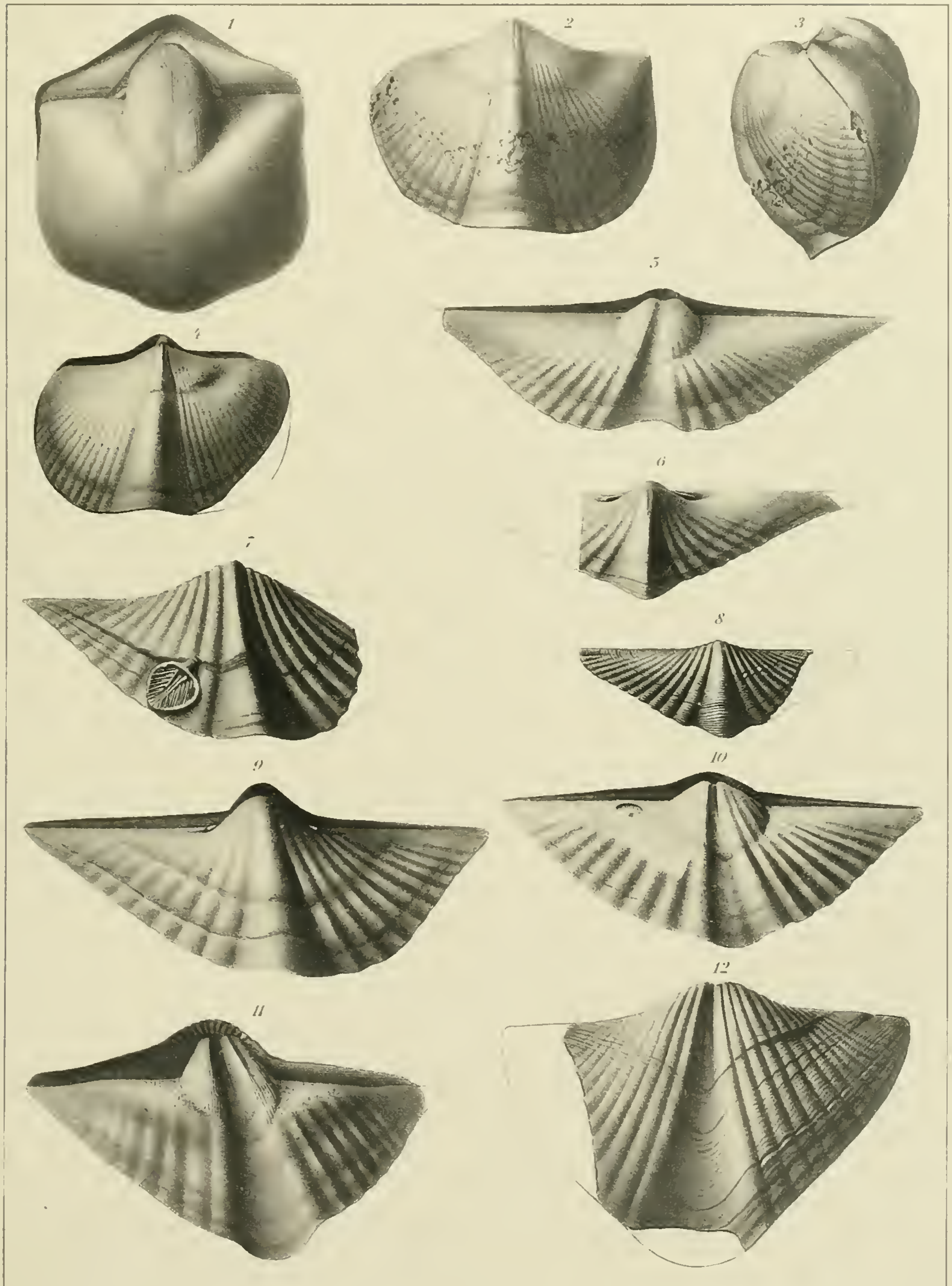

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PLATE 20

**Spirifer** cf. **concinnus** Hall

Page 85

1–3 Internal casts of shells having some of the characters of this species

4 An exterior of the dorsal valve

*Locality.* Near Soccatean point, Moosehead lake

**Spirifer aroostookensis** Clarke

(*See* plates 30, 34)

Page 85

5 Fragment of exterior of a ventral valve showing the flat depressed or sulcate ribs and narrow radial grooves

*Locality.* Tomhegan point, Moosehead lake

**Spirifer primaevus** Steininger var. **atlanticus** Clarke

(*See* plate 19)

Page 82

6, 7 Enlargements of the fimbriate sculpture from different specimens. 6, x 5; 7, x 10

**Spirifer** sp.?

Page [illegible]

8–14 A series of illustrations of a small, transversely elongate species whose specific relationships are not clearly determined

*Locality.* Telos lake dam

**Leptocoelia flabellites** (Conrad)

(*See* plate 34)

Page 81

15 Ventral aspect of an internal cast with part of the shell adhering. x 1½

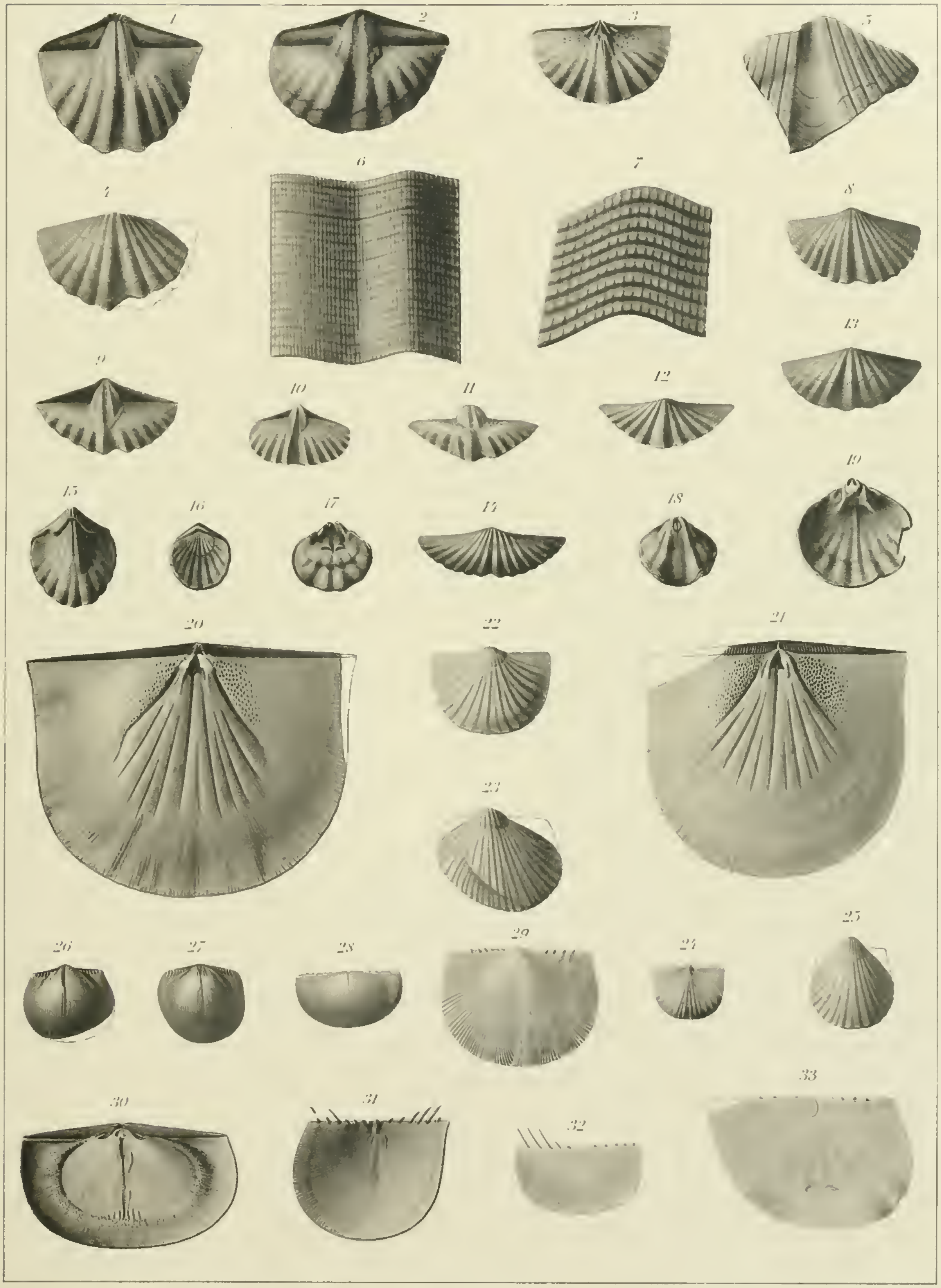
16 Dorsal aspect of the exterior. These two shells are not satisfactory illustrations of the species and the drawings give them much the aspect of a Coelospira, but this is an entirely misleading effect, overlooked in the correction of the workmanship.

17, 18 Dorsal and ventral sides of an internal cast. Compare with specimens from the Pine Hill Oriskany on plate 34.

19 Interior of dorsal valve showing structure of cardinal process

Localities as noted on page 81

# MOOSE RIVER SANDSTONE

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### Leptostrophia magnifica Hall

(See plate 21)

Page 87

20, 21 Internal casts of ventral valves

*Locality.* Matagamon lake dam

### Chonetes nectus Clarke

Page 80

22, 23 Exteriors of ventral valves. x 3

24 Interior of dorsal valve. x 3

25 Exterior of ventral valve. x 3

*Locality.* Tomhegan point, Moosehead lake

### Chonetes (Eodevonaria) hudsonicus Clarke

Page 86

26, 27 Internal ventral casts showing the cardinal denticulations

*Locality.* Stony brook, Moose river

28 A transversely elongated ventral valve

*Locality.* Tomhegan point, Moosehead lake

### Chonetes impensus Clarke

Page 85

29 The shell described, a ventral valve

*Locality.* Seven miles north of Kineo bay, Moosehead lake

### Chonostrophia dawsoni Billings

Page 87

30 Internal cast of the ventral valve

*Locality.* Seven miles north of Kineo bay, Moosehead lake

31 Exterior of the ventral valve with cardinal spines

*Locality.* Misery stream, town of Sandwich

32 Interior of the ventral valve retaining the spines

33 Exterior of a slightly distorted ventral valve

*Locality.* Seven miles north of Kineo bay, Moosehead lake

PLATE 21

**Chonetes canadensis** Billings

Page 86

1 Interior of a ventral valve with strong radial pallial sinuses

2 Internal cast of ventral valve indicating a strong median septum

3 Exterior of a distorted ventral valve showing the coarse median stria

4 Interior of a portion of the dorsal valve

*Locality.* Misery stream

**Dalmanella** cf. **circularis** (Sowerby)

Page 88

5 Exterior of a dorsal valve

6 Interior of a dorsal valve

7 Internal cast of a ventral valve

*Locality.* Jackman farm

**Rhipidomella musculosa** Hall var. **solaris** Clarke

Page 88

8 Exterior of a ventral valve

9 Interior of a dorsal valve

10, 11 Internal casts of ventral valves

*Localities.* Figures 8, 10, 11, Tomhegan point, Moosehead lake; 9, Jackman farm

**Hipparionyx proximus** Vanuxem

Page 88

12 Internal cast of a ventral valve

*Locality.* Cunningham's camp, near Matagamon lake

**Leptostrophia oriskania** Clarke

Page 87

13, 14 Two specimens viewed from the ventral surface

*Locality.* Matagamon lake

**Leptostrophia magnifica** Hall

(*See* plate 20)

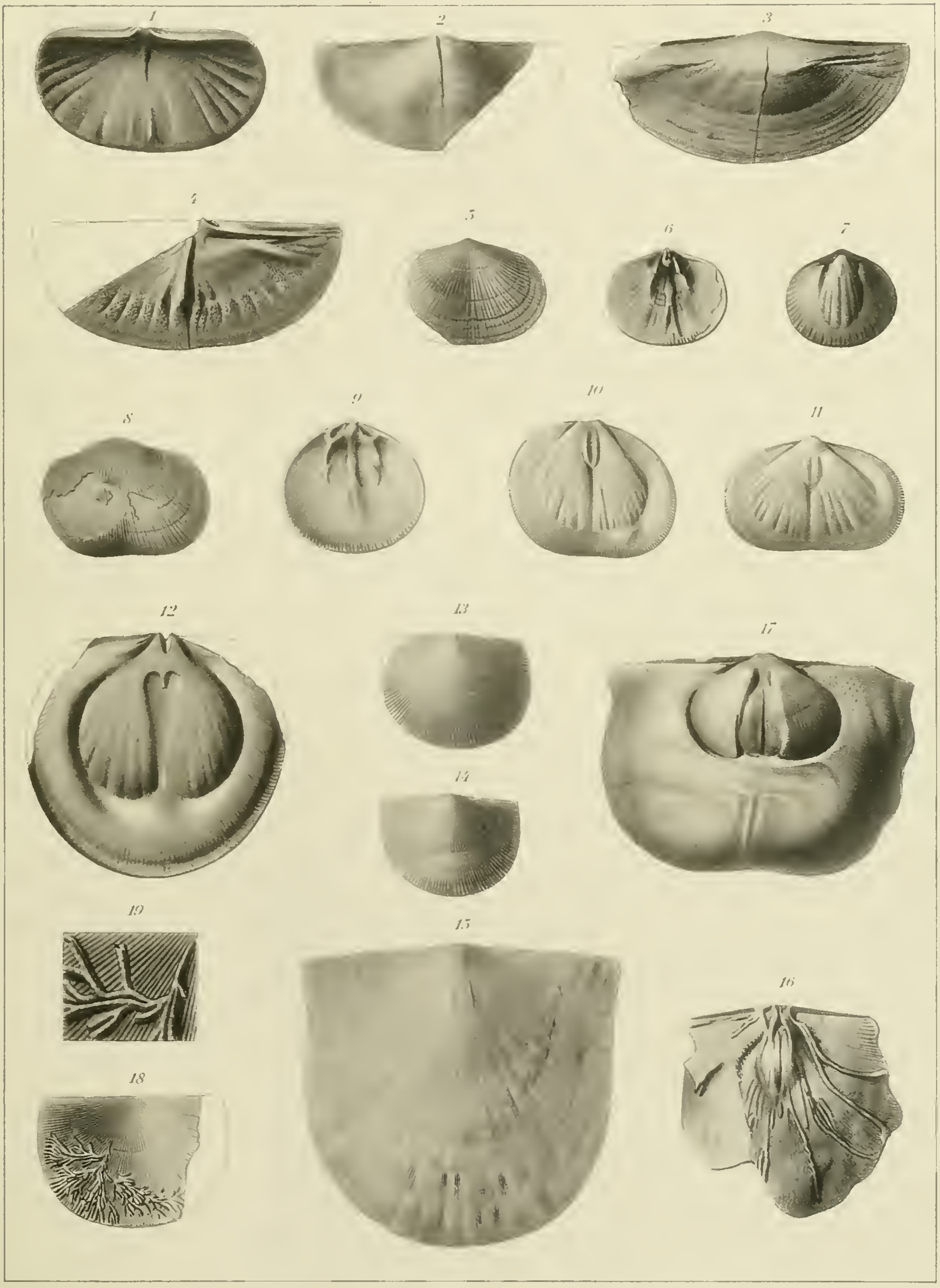
Page 87

15 Exterior of a ventral valve

*Locality.* Matagamon lake

# MOOSE RIVER SANDSTONE



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16 Internal cast of ventral valve bearing tube fillings of a perforating sponge, Clionolithes priscus (McCoy)

*Locality.* Stony brook, Moose river

**Leptaena rhomboidalis** (Wilckens) var **ventricosa Hall**

Page 87

17 A large and characteristic internal ventral cast

*Locality.* Stony brook, Moose river

**Hederella** sp.

18 A dorsal valve of Leptostrophia oriskania with an attached colony of this genus

19 A portion of the colony enlarged

*Locality.* Seven miles north of Kineo, Moosehead lake

PLATE 22

**Phacops (Phacopidella) nylanderi** Clarke

Page 96

1 The cephalon. x 2
*Locality.* Edmunds Hill

**Homalonotus vanuxemi** Hall

(*See* plate 12)

Page 95

2, 3 Imperfect cephala, the latter somewhat compressed vertically
4 A pygidium
5, 6 Profile and upper views of a smaller pygidium
*Locality.* Edmunds Hill

**Dalmanites** cf. **micrurus** (Green)

(*See* plate 1)

Page 96

7, 8 Small pygidia doubtfully referred to this species
*Locality.* Edmunds Hill

**Tentaculites scalaris** Schlotheim

Page 98

9 A tube of natural size
10 An enlargement
11 Still further enlargement to show the character of the annulations
*Locality.* Edmunds Hill

**Conularia** cf. **huntiana** Hall

Page 98

12, 13 Fragments showing rather unsatisfactorily the character of the ornament
*Locality.* Presque Isle stream

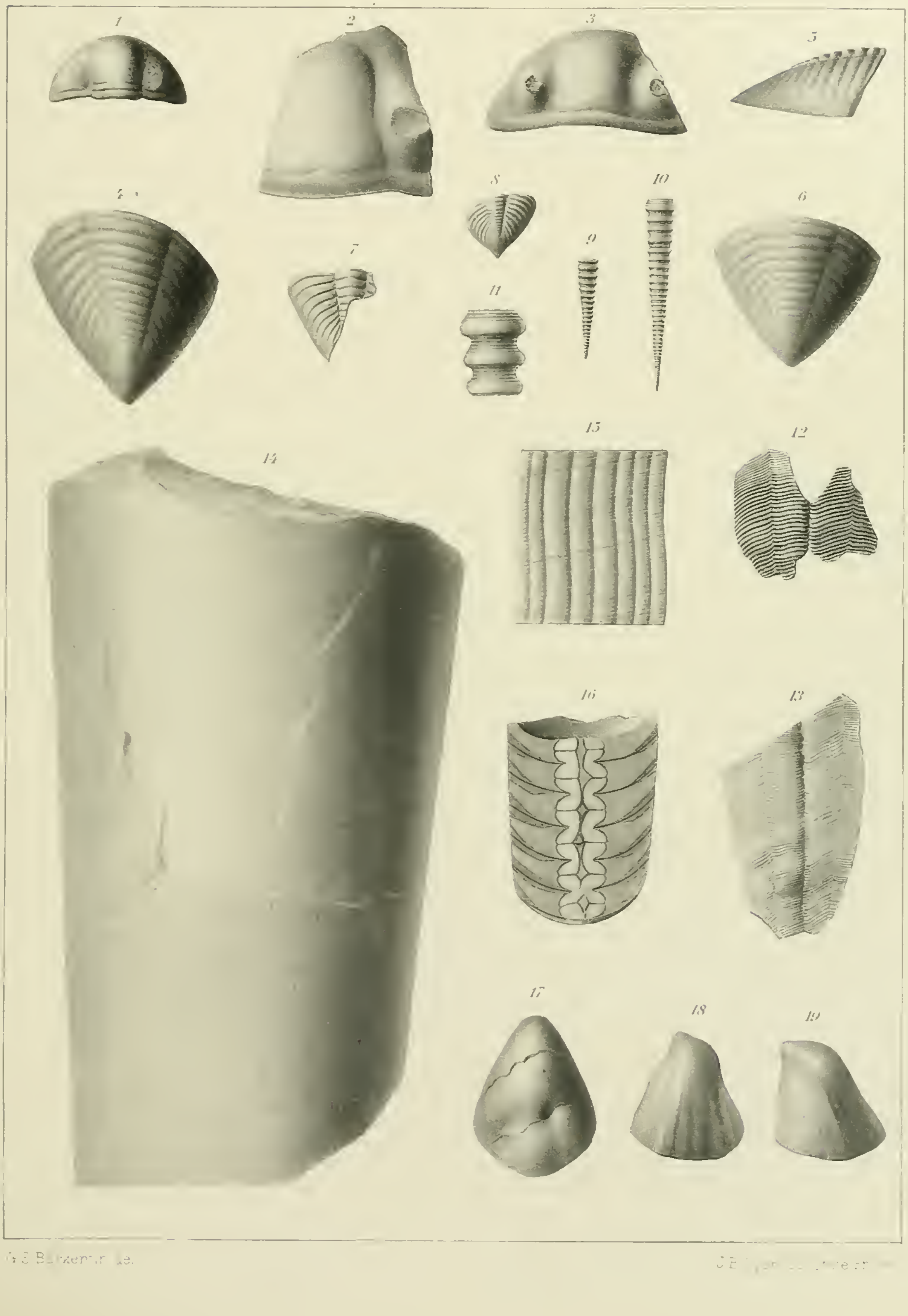
**Orthoceras norumbegae** Clarke

Page 97

14, 15 Portion of a large shell and enlargement of its sculpture
*Locality.* Edmunds Hill

# CHAPMAN SANDSTONE





**Orthoceras** sp.

16 Vertical median section through a specimen of undetermined species, showing siphuncle and siphuncular beads together with thickened septal deposits

*Locality.* Presque Isle stream

**Platyceras hebes** Clarke

(*See* plate 12)

Page 101

17–19 Three illustrations of this species

*Locality.* Edmunds Hill

PLATE 23

**Platyceras leboutillieri** Clarke

(*See* part 1, plate 14)

Page 101

1 An example of this Gaspé shell

*Locality.* Edmunds Hill

**Platyceras kahlebergensis** Beushausen

Page 102

2, 3 Two views of an internal cast showing the corrugated exterior

4–7 Other internal casts with similar characters

*Locality.* Edmunds Hill

**Coelidium tenue Clarke**

Page 99

8–10 Three views showing the exterior

*Locality.* Presque Isle stream

**Eotomaria hitchcocki** Clarke

Page 100

11–19 A series of illustrations all natural size except 17 and 18 which are x 2; showing all the essential characters of the exterior and interior of the shells

*Locality.* Presque Isle stream

**Holopea beushauseni** Clarke

Page 101

20–22 Internal casts showing the character of the spire and the expanded lip

*Locality.* Presque Isle stream

**Holopea** sp.

23, 24 Specimens of an unidentified shell

*Locality.* Edmunds Hill

**Loxonema** sp. cf. **funatum** A. Roemer

Page 102

25, 26 Specimens in the usual condition of preservation

*Locality.* Edmunds Hill

# CHAPMAN SANDSTONE

**Tropidodiscus obex** Clarke

Page 99

27, 28 Two views of the same specimen

29, 30 Lateral views of other examples

*Locality.* Edmunds Hill

PLATE 24

**Plectonotus cf. derbyi** Clarke

Page 98

1-11 Various views of this shell showing the essential characters as preserved on internal and external casts. Figures 1, 2, 4, 7, 8 are enlarged. x 2

*Locality.* Presque Isle stream

**Pterinea edmundi** Clarke

Page 103

12-14 Left valves showing some variation in form

15 A right valve

16, 17 Other left valves, 17 somewhat angulated by compression along the crescence ridge

18 A very oblique, probably compressed right valve

*Locality.* Edmunds Hill

**Pterinea edmundi** var. **subrecta** Clarke

Page 104

19, 20 Right and left valves of this variety

*Locality.* Edmunds Hill

**Pterinea radialis** Clarke

(*See* plates 13, 14)

Page 103

21, 23, 24 Left valves

22 Umbonal portion of internal cast of right valve. x 2

*Locality.* Presque Isle stream

**Pterinopecten aroostooki** Clarke

Page 105

25-28 Left valves showing form and sculpture

*Locality.* Edmunds Hill

**Pterinea** sp.

Type of P. laevis Goldfuss

Page 104

29, 30, 33 Internal casts of shells apparently without radial sculpture

*Localities.* Edmunds Hill and Presque Isle stream

# CHAPMAN SANDSTONE



**Pterinea ?** sp.

31, 32 Oblique shells with rounded hinge angles and pterineoid hinge, but of uncertain generic relations

*Locality.* Presque Isle stream

PLATE 25

**Pterinea cf. fasciculata** Goldfuss

Page 102

1, 2 Casts of the hinge in left valves. x 2. The umbones have been removed to expose the ligament surface and the dentition

3, 4 Internal casts of left valves

5, 6 Exteriors of left valves showing sculpture

7 Internal cast of a right valve

*Locality.* Presque Isle stream

**Pteronitella peninsulae** Clarke

Page 105

8, 9 Internal casts of right valves with clearly defined muscle and pallial scars

*Locality.* Presque Isle stream

**Pterinea brisa** Clarke

Page 104

10 A right valve showing character of exterior

*Locality.* Edmunds Hill

**Pterinea chapmani** Clarke

Page 103

11 A left valve

*Locality.* Edmunds Hill

**Myalina pterinaeoides** Clarke

(*See* plate 26)

Page 106

12 Enlargement of a portion of the exterior surface

13, 14 Internal cast and internal surface of a right valve

15 Internal cast of right valve

16 Exterior of a right valve

17, 18 Internal casts of left valves

*Locality.* Presque Isle stream

# CHAPMAN SANDSTONE



PLATE 26

**Myalina pterinaeoides** Clarke

(*See* plate 25)

Page 106

1, 2 Internal casts of left and right valves

3 A right valve retaining a portion of its thick shell

*Locality.* Presque Isle stream

**Modiomorpha protea** Clarke

(*See* plate 27)

Page 107

4–8 A series of illustrations showing the aspect of this species and its variation in form

*Localities.* Edmunds Hill and Presque Isle stream

**Modiomorpha vulcanalis** Clarke

Page 106

9, 11 Characteristic right valves, showing the very heavy shell

10 Sculpture cast of a left valve of greater obliquity and less angularity than the others

*Locality.* Edmunds Hill

# CHAPMAN SANDSTONE



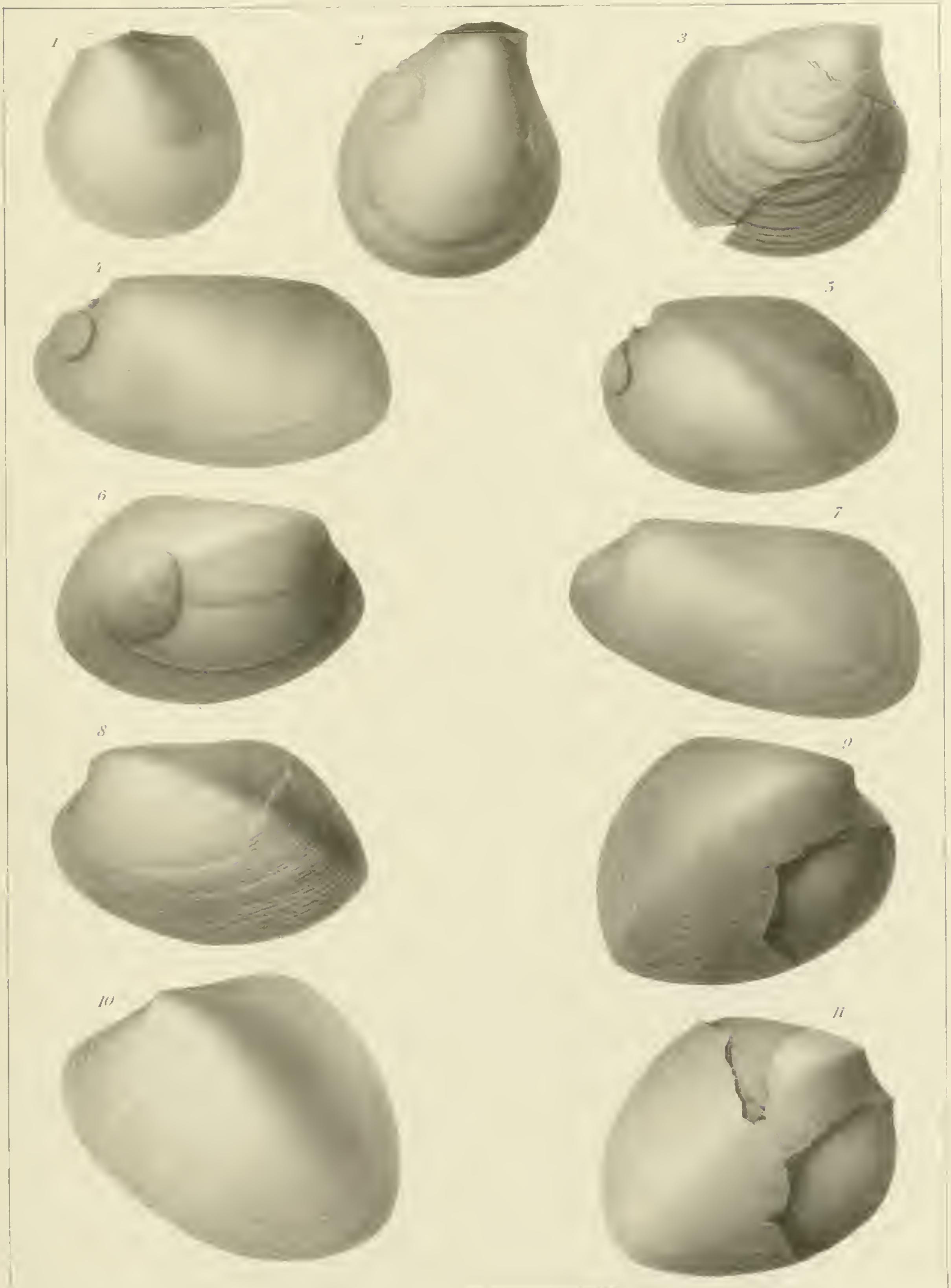



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PLATE 27

**Grammysia modiomorphae** Clarke

Page 108

1–6, 8 A series of illustrations, largely from sculpture casts
*Locality*. Edmunds Hill

**Modiomorpha protea** Clarke

(*See* plate 26)

Page 107

7 A small specimen of this species
*Locality*. Edmunds Hill

**Cyrtodonta** or **Modiomorpha**

9 *Locality*. Edmunds Hill

**Modiomorpha** sp.

Page 107

10 A left valve of uncertain relations
*Locality*. Edmunds Hill

# CHAPMAN SANDSTONE




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PLATE 28

**Palaeosolen cf. simplex** Maurer

(*See* plate 17)

Page 111

1 A right valve with the crescence ridge developed by compression. x 2

2–4 Other valves of this species; figure 4. x 2

*Locality.* Presque Isle stream

**Cypricardella** sp.

Page 111

5 Sculpture cast of a left valve

*Locality.* Presque Isle stream

**Leptodomus corrugatus** Clarke

Page 109

6 A right valve

*Locality.* Presque Isle stream

**Allerisma** sp.

7 *Locality.* Moose River sandstone, Misery stream

**Leptodomus communis** Clarke

Page 108

8 A left valve provisionally regarded as of this species

9, 10 Characteristic left valves

*Locality.* Presque Isle stream

**Nuculites** cf. **oblongatus** Conrad and **ellipticus** Maurer

Page 111

11 The single valve observed

*Locality.* Edmunds Hill

**Palaeoneilo circulus** Clarke

Page 110

12–14 Left valves

*Locality.* Presque Isle stream

**Palaeoneilo** sp.?

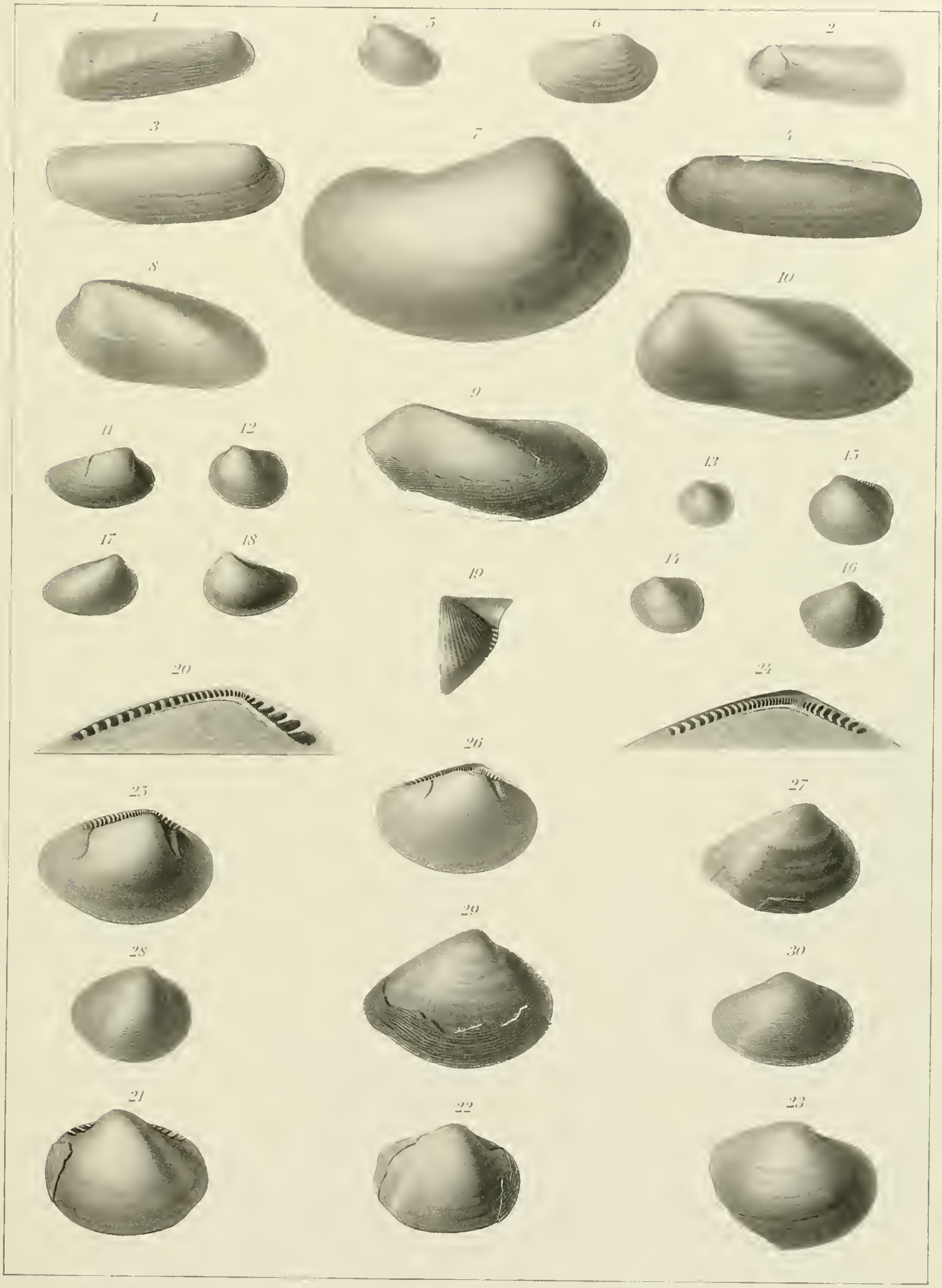
Page 111

15, 16 Left and right valves of a species not satisfactorily identified, with gently sinuate posterior slope

*Locality.* Presque Isle stream

# CHAPMAN SANDSTONE



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**Nucula cf. krachtae** A. Roemer

Page 111

17, 18 Casts of opposite valves

*Locality.* Presque Isle stream

**Conocardium cf. inceptum** Hall

Page 112

19 An internal cast

*Locality.* Edmunds Hill

**Palaeoneilo orbignyi** Clarke

Page 109

20 Enlargement of cast of hinge of right valve. x 3

21–23 Internal casts of valves

*Locality.* Presque Isle stream

**Palaeoneilo mainensis** Clarke

Page 110

24 Cast of hinge of right valve. x 3

25, 26 Internal casts of right valves, the latter showing some departure from the normal in outline of the shell

27–30 Other valves of this species

*Locality.* Presque Isle stream

PLATE 29

**Rensselaeria atlantica** Clarke

Page 112

1, 2 Ventral and profile views of an internal cast

3 Exterior surface of a ventral valve

4 Enlargement of the surface

5 Dorsal view of an entire specimen retaining the shell

6 Interior view of the ventral valve

7, 8 Dorsal views of internal casts

9, 10 Dorsal and ventral views of an internal cast showing details of muscular and cardinal structure

11 Internal cast of ventral valve

12 A dorsal valve retaining the shell

13–15 Three views of a finely preserved sculpture cast

16 Internal cast of a large ventral valve

17 Interior of a dorsal valve

18 Cast of the umbonal portion of a dorsal valve. x 2

*Localities.* Figures 1, 2, 9–18, Presque Isle stream; 3–8, Edmunds Hill

**Rensselaeria** nov.

Page 115

19 Sculpture cast of a ventral valve of subcircular form and finely marked surface

*Locality.* Edmunds Hill

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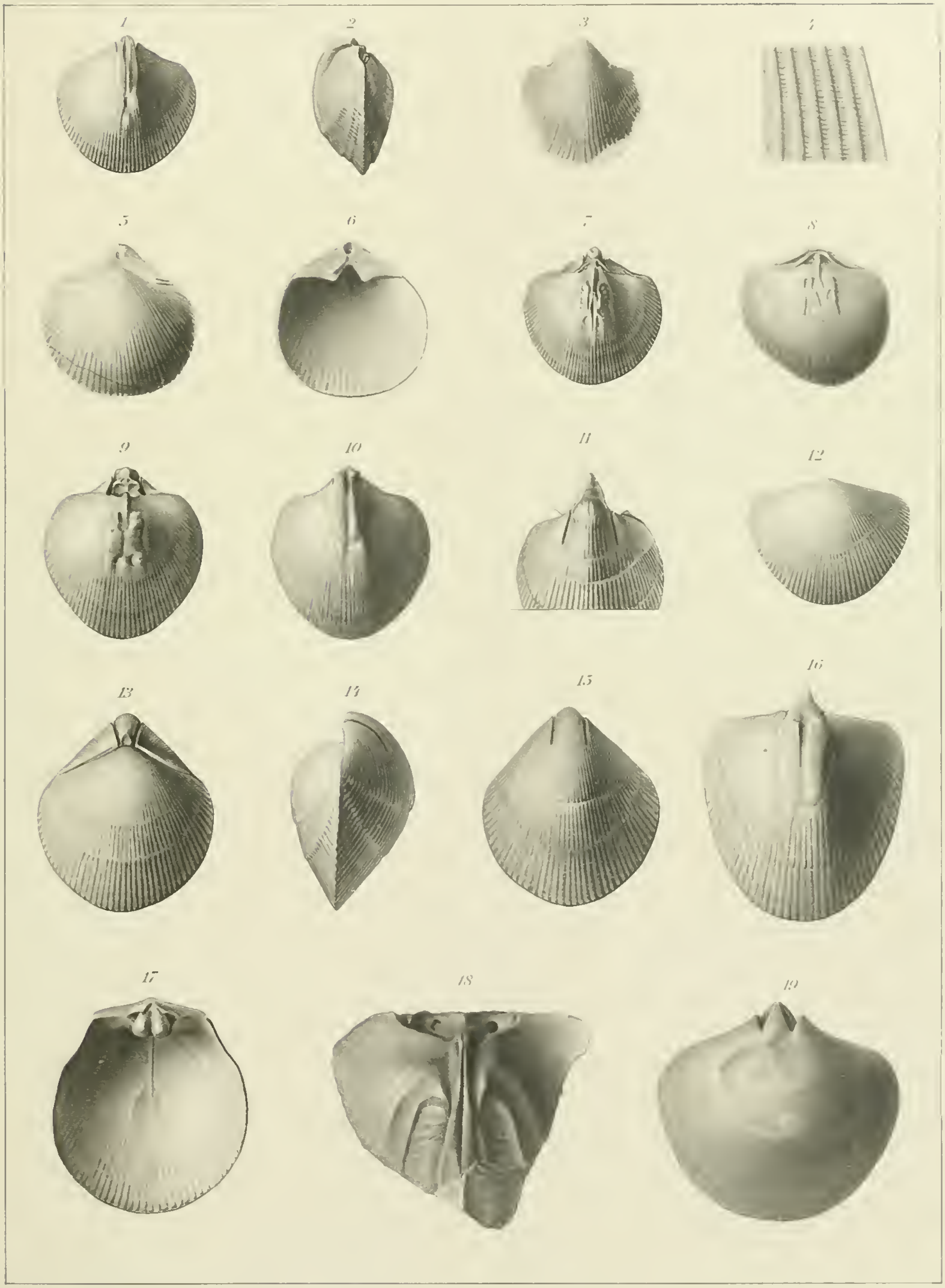

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PLATE 30

**Camarotoechia dryope** (Billings)

Page 112

1 A dorsal valve

*Locality.* Edmunds Hill

**Camarotoechia** sp.

Page 112

2 Cast of a ventral valve

*Locality.* Edmunds Hill

**Spirifer macropleuroides** Clarke

Page 119

3 Dorsal view of the type specimen

4 Enlargement of the surface

*Locality.* Edmunds Hill

**Spirifer aroostookensis** Clarke

(*See* plate 34)

Page 119

5 The type specimen, a dorsal valve

9 Enlargement of the surface. x 10

*Locality.* Edmunds Hill

**Spirifer cymindis** Clarke

Page 117

6 Internal cast of ventral valve

7 Exterior of ventral valve

8 Exterior of dorsal valve

10, 11 Internal casts of ventral and dorsal valves

*Locality.* Edmunds Hill

**Spirifer cymindis** var. **sparsa** Clarke

Page 118

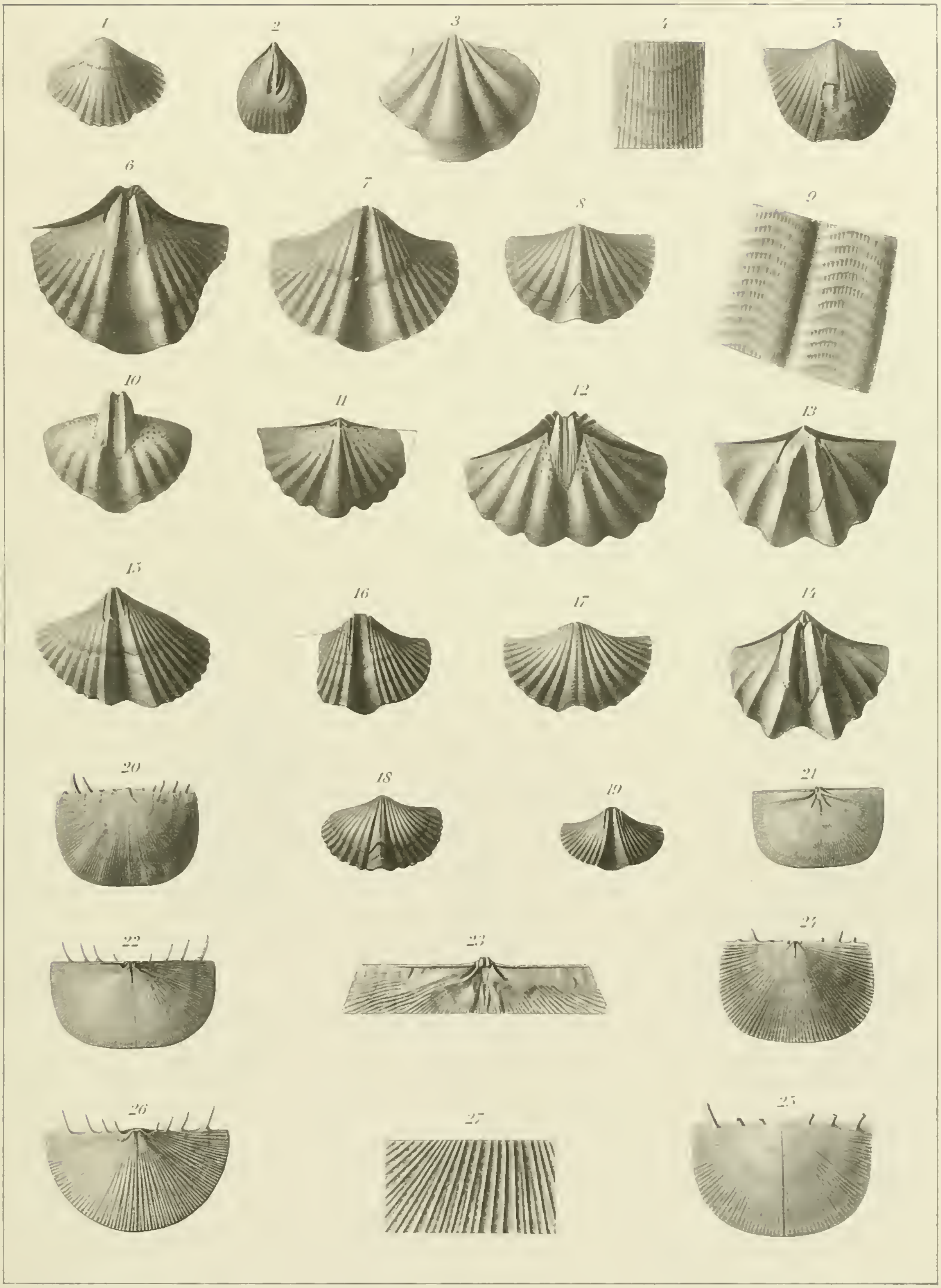
12 Internal cast of ventral valve not typical of the variety but showing features of plication between that and the species

13, 14 Internal casts of two ventral valves with sparse angular plications. x $1\frac{1}{2}$

*Locality.* Edmunds Hill

# CHAPMAN SANDSTONE



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**Spirifer subcuspidatus** Schnur var. **lateincisus** Scupin

Page 116

15, 16 Internal casts of ventral valves

17 Exterior of dorsal valve

18 Internal cast of dorsal valve

19 Internal cast of ventral valve

*Locality*. Presque Isle stream

**Chonetes aroostookensis** Clarke

Page 120

20 Ventral valve, somewhat more rhomboidal than usual

21 Interior of a dorsal valve

22 Internal cast of a ventral valve

23 The dorsal hinge. x 2

24 Internal cast of a ventral valve. x 3

25 Exterior of a small ventral valve. x 3

*Locality*. Edmunds Hill

**Chonetes paucistria** Clarke

Page 122

26 Sculpture cast of ventral valve showing the relatively sparse and sharp plication. x 2

27 Enlargement of the surface. x 4

*Locality*. Edmunds Hill

PLATE 31

**Orthothetes (Schuchertella) deformis** Hall

Page 124

1–4 Views of ventral valves of this species

*Locality.* Edmunds Hill

**Leptostrophia magnifica** Hall protype **parva** Clarke

Page 123

5–9 Exteriors and internal casts showing the prevailing habit of this shell

*Locality.* Edmunds Hill.

**Dalmanella drevermanni** Clarke

Page 125

10–12 Three views of the shell natural size

14 Exterior of a dorsal valve. x 2

15 Interior of a dorsal valve (figure 12). x 2

*Locality.* Edmunds Hill

**Orthis** sp.

Page 125

13 Internal cast of dorsal valve allied to O. personata Zeiler. x $1\frac{1}{2}$

**Hipparionyx minor** Clarke

Page 124

16 Cardinal view of a dorsal valve showing elevation of cardinal process

17, 18 Exteriors of ventral valves

19, 20 Dorsal valves

21 Interior of ventral valve

22 Enlargement of surface sculpture. x 5

*Locality.* Edmunds Hill

**Orbiculoidea** cf. **ampla** Hall and **siegenensis** Kayser

Page 126

23, 24 *Locality.* Presque Isle stream

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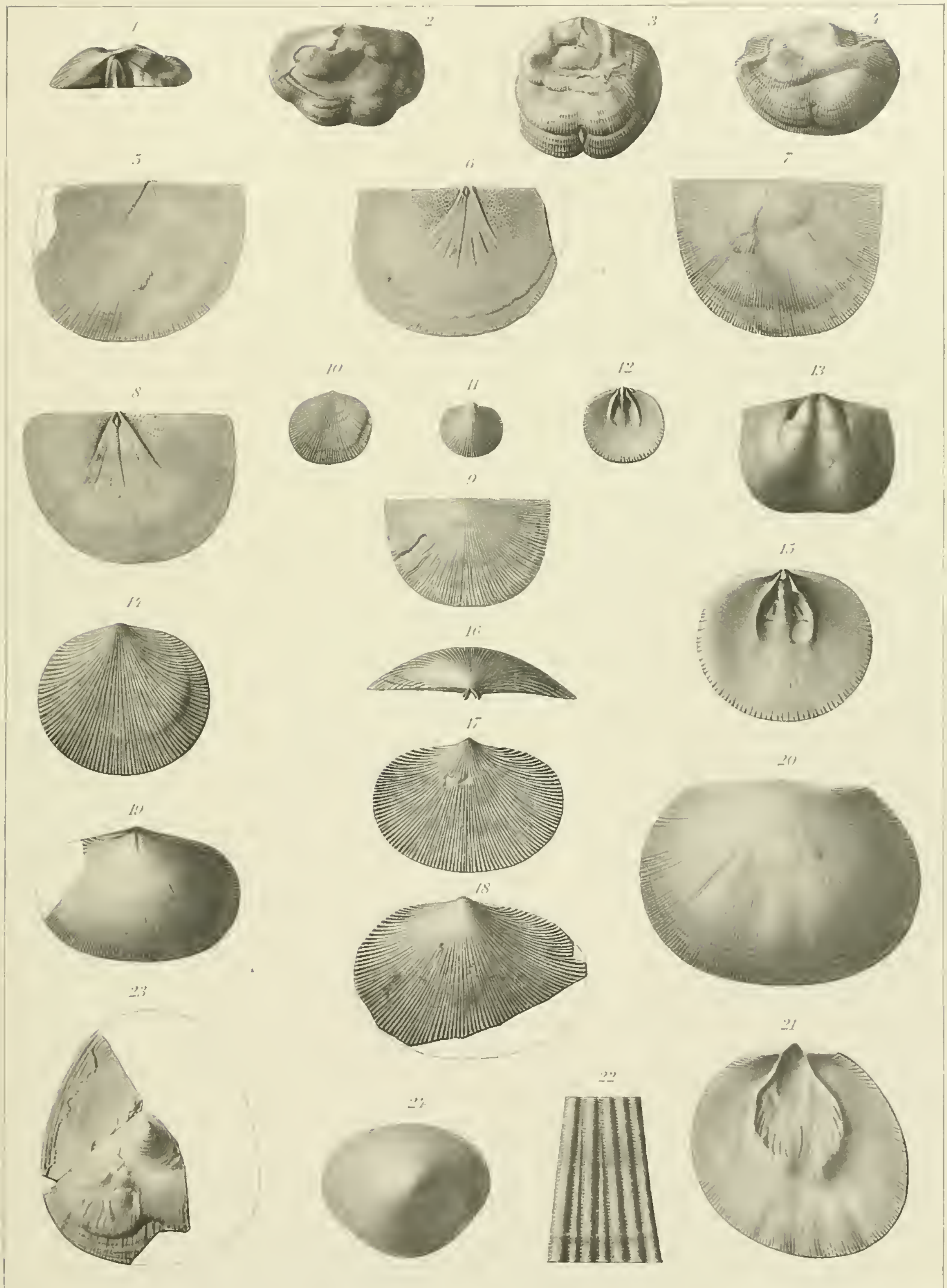

PLATE 32

**Autodetus beecheri** Clarke

Page 138

1, 2 Views of an internal cast of this annelid tube. x 3
*Locality.* Pine Hill, N. Y.

**Dalmanites emarginatus** Hall

Page 138

3 Characteristic fragment of the pygidium. x 2
*Locality.* Pine Hill, N. Y.

**Tropidocyclus brevilineatus** (Conrad)

Page 139

4, 5 Side views of two individuals, natural size
6, 7 Edge and side views of a young specimen. x 3
*Locality.* Pine Hill, N. Y.

**Tentaculites elongatus** Hall

Page 138

8 Two tubes of this species. x 2
*Locality.* Pine Hill, N. Y.

**Coleolus acus** Clarke

Page 138

9–15 A series of illustrations showing the exterior characters of this tube and its variations in curvature. x 1½ (10, 11, x 2)
*Locality.* Pine Hill, N. Y.

**Diaphorostoma pastillus** nov.

Page 140

16, 17 Lateral and apical views of a characteristic example showing the surface sculpture. x 2
18 Stomal view of an incomplete example. x 3
19, 20 Lateral views. 19, x 3; 20, x 2
*Locality.* Pine Hill, N. Y.

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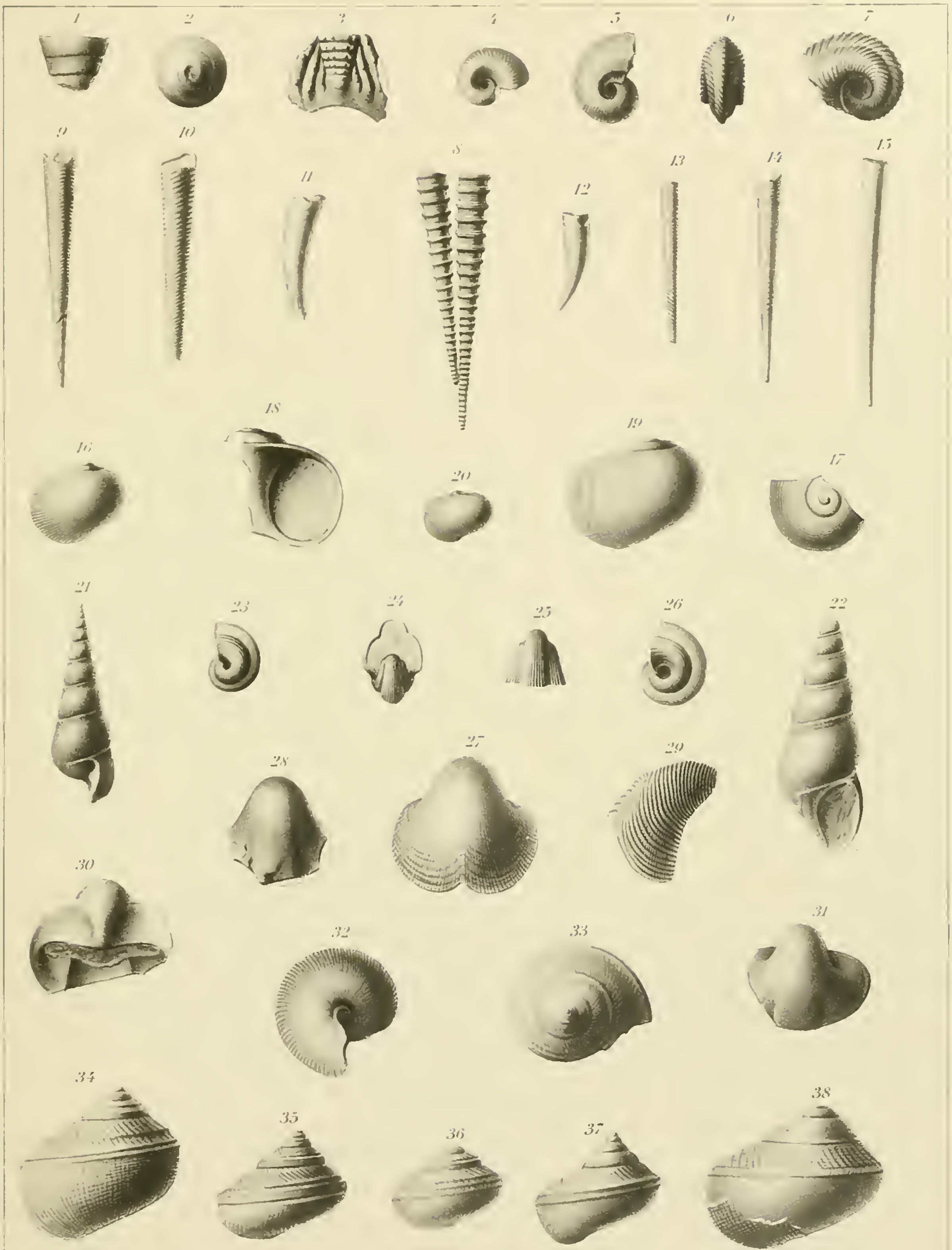

**Loxonema highlandense** nov.

Page 140

21 Exterior of a typical example

22 Internal cast of a larger shell

*Locality.* Pine Hill, N. Y.

**Tropidocyclus rotalinea** (Hall)

Page 139

23 Side view of a small specimen. x 2

24–26 Views of a larger example. x 2

*Locality.* Pine Hill, N. Y.

**Phragmostoma nitela** nov.

Page 139

27 Dorsal view showing exterior and sculpture. x 1½

28 Internal cast

29 Enlargement of surface sculpture. x 1½

30 View showing the platform-shaped callus on the inner lip

31 Internal cast

*Locality.* Pine Hill, N. Y.

**Pleurotomaria haedillus** nov.

Page 138

32–38 A series of illustrations showing the variations in this species. x 2 (37, x 5)

*Locality.* Pine Hill, N. Y.

PLATE 33

**Nuculites fraxinus** nov.

Page 141

1 An internal cast of the left valve

2 Cast of the hinge of the right valve. x 3

3, 4 Interiors of right valves showing the hinge and strong clavicle. (3, x 1½; 4, x 2)

*Locality.* Pine Hill, N. Y.

**Nuculites (Ditichia) doto** nov.

Page 140

5–8, 10 Internal casts of valves showing the degree of development of the clavicular ridges. (5, 7, x 2; 6, 10, x 3; 8, x 1½)

9 Cast of the hinge of the right valve. x 3

*Locality.* Pine Hill, N. Y.

**Carydium gregarium** Beushausen

(*See* plate 5)

Page 141

11, 12 Internal cast of left valve, natural size and x 5, the latter showing the character of the hinge

13, 14 Similar internal casts showing the denticulated ridge (groove). (13, x 3; 14, x 5)

**Macrodus ? desuetus** nov.

Page 141

15 Internal cast of right valve showing the hinge structure. x 1½

16, 17 Internal cast and exterior of other valves. x 1½

*Locality.* Pine Hill, N. Y.

**Goniophora cercurus** nov.

Page 141

18 Sculpture cast of right valve showing part of hinge

19 Internal cast with radial pallial markings well defined

20 Exterior, showing normal form and sculpture

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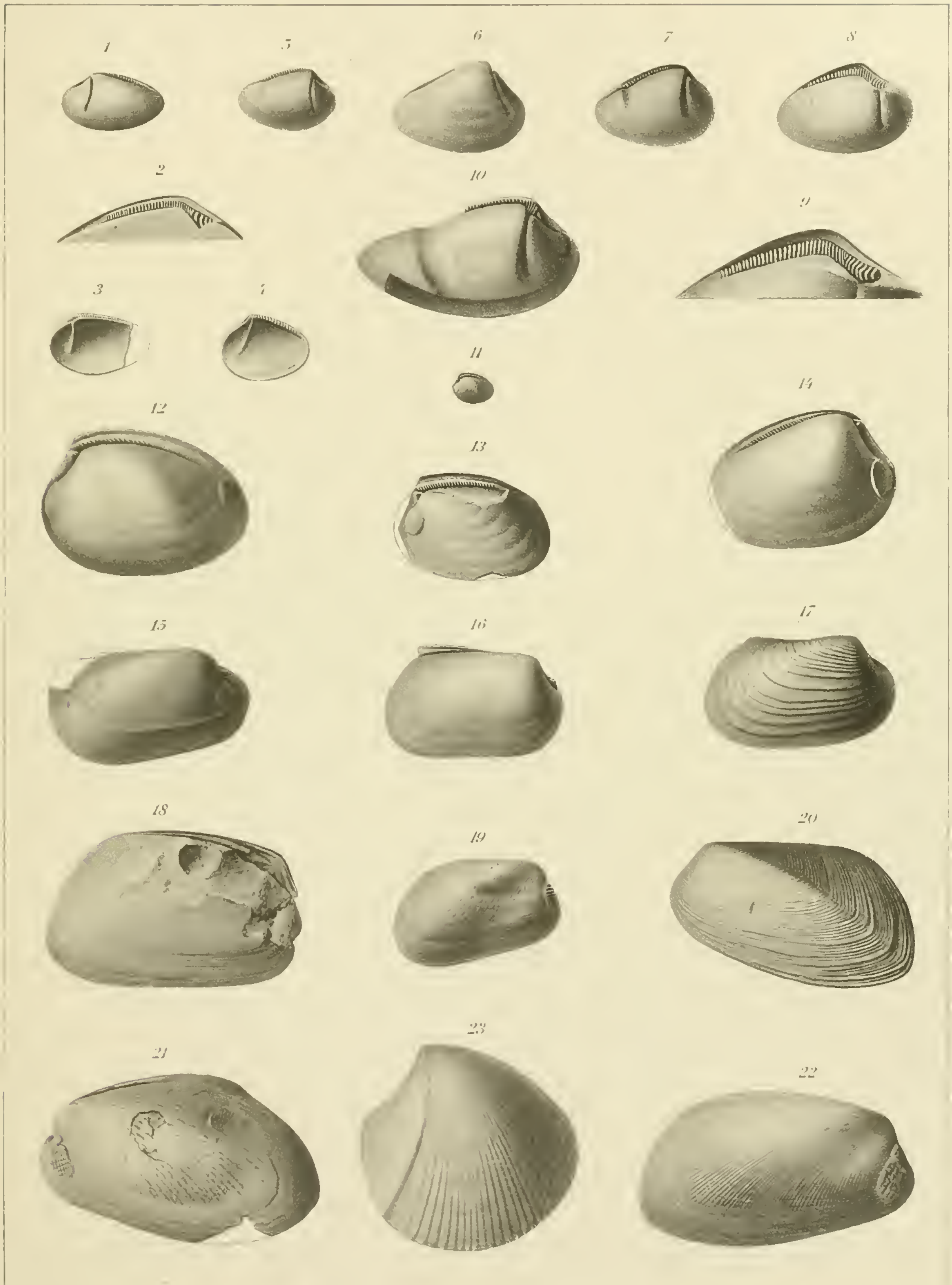


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21, 22 Internal casts showing the variation in the character of the pallial markings

*Locality.* Pine Hill, N. Y.

**Lunulicardium ? sp.**

Page 141

23 A left valve

*Locality.* Pine Hill, N. Y.

PLATE 34

**Megalanteris diobolaris nov.**

Page 142

1, 2 Internal casts of ventral valves

3 Internal cast of a dorsal valve

4 Exterior of a ventral valve

5 Internal cast of a ventral valve

*Locality.* Pine Hill, N. Y.

**Spirifer aroostookensis Clarke**

(*See* plates 30, 34)

Page 143

6 Exterior of a dorsal valve

7 Exterior of a ventral valve. The radial striations here shown on the sinus are seldom seen.

8 A ventral valve

9, 10 Enlargements of the surface showing the flattened slightly sulcate ribs and their fimbriate character

11 Internal cast of ventral valve

12, 13 Exteriors of dorsal and ventral valves

14 A small dorsal valve with rugose margin

15, 16 Dorsal and profile views of an entire specimen. x 1½

*Locality.* Pine Hill, N. Y.

**Leptocoelia flabellites** (Conrad)

Page 142

17–20 A series of figures showing the usual character of this species in this fauna

*Locality.* Pine Hill, N. Y.

**Chonetes (Eodevonaria) cf. arcuata** Hall nov.

Page 144

21–31 A series of views illustrating the various external and internal characters of this shell. Natural size (23, x 2)

*Locality.* Pine Hill, N. Y.

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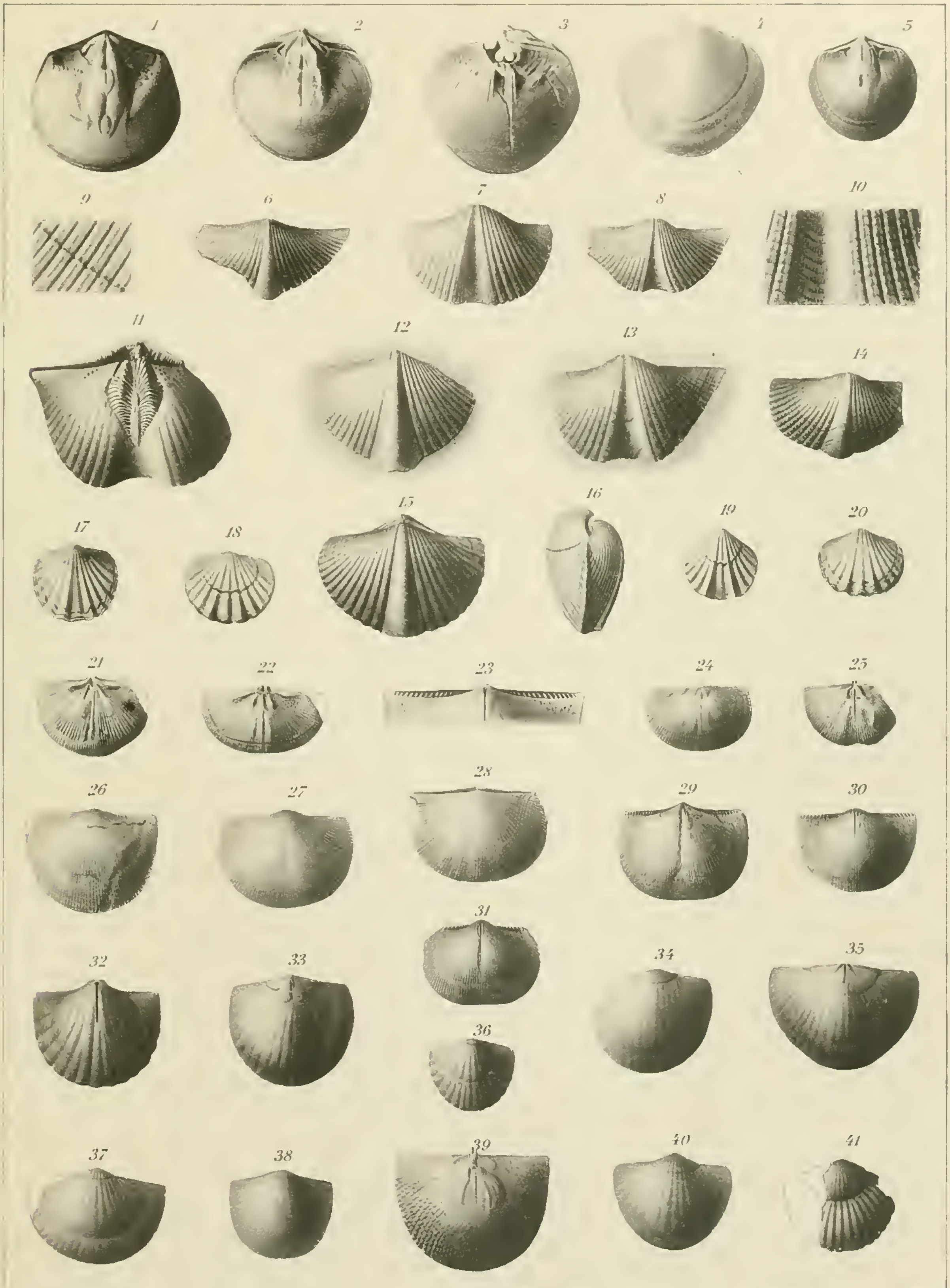


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**Chonetes highlandensis** nov.

Page 144

32–41 A series of illustrations showing the characters and variations of this species. All x 3

*Locality.* Pine Hill, N. Y.

# INDEX

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